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An Analysis of Beverage Consumption in the United States Using the National Health and Examination Survey 2007-2017

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AN ANALYSIS OF BEVERAGE CONSUMPTION IN THE UNITED STATES USING THE NATIONAL HEALTH AND EXAMINATION SURVEY 2007-2017

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ABSTRACT

Sugar-Sweetened Beverages (SSBs) are liquids sweetened with various forms of added sugar. They are the leading source of calories and added sugar in the American diet (Drewnowski & Rehm, 2014; National Cancer Institute, 2016; Powell, Chriqui, Khan, Wada, & Chaloupka, 2013). The health and nutrition literature has increasingly identified added sugars and SSBs as a key potential contributor to a host of public health issues including obesity, type 2 diabetes, hypertension, and cardiovascular disease (Johnson et al., 2009; Malik, Popkin, Bray, Despres, & Hu, 2010; Vartanian, Schwartz, & Brownell, 2007). Concern about these public health crises has recently animated regional and local campaigns to attempt to limit consumption of these items through taxes and other policies. These policy proposals have raised demand for information and research about the drivers and effects SSB and beverage consumption in general.

This study documents the major systems that have been used to categorize different types of SSBs and proposes a new beverage categorization typology – the Synthesized Beverage Categorization System – that cross references information from the What We Eat In America Food Categories and the Food Patterns Equivalents Database to offer the most precise SSB typology available today.

The remaining sections use reported dietary intake data from the National Health and Nutrition Examination Survey (NHANES) to analyze consumption patterns of sugary beverage subtypes in a number of ways. First this study lays the groundwork for future studies of beverage consumption by examining consumption patterns of major SSB subtypes for adults and children by a number of variables commonly used in dietary intake analysis. Second, this article provides an analysis of sociodemographic trends in the consumption of several major sugary-beverage subtypes by age group, race and gender. Finally, consumption patterns of conventional and “non-traditional” SSBs are provided for the last 4 NHANES data collection cycles to analyze recent trends in reported intake of calories and added sugars from sugary beverages.

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EI – energy intake. Refers specifically to caloric intake. EI is commonly used in validation studies of dietary reporting and dietary studies in general.

FNDDS – Food and Nutrient Database for Dietary Studies. The food coding system developed by the USDA and used in the NHANES.

FPED – Food Patterns Equivalents Database. A database containing added sugar content for foods included in the FNDDS categories.

NHANES – National Health and Nutrition Examination Survey. A survey based on a nationally representative sample of Americans conducted by the CDC on a two year cycle.

SSB – Sugar sweetened beverage. Also called calorically sweetened beverages or sugary beverages.

SBCS –Synthesized Beverage Categorization System

WWEIA – What We Eat In America. This is the dietary portion of the NHANES developed as a partnership between the USDA and the DHHS.

CHAPTER 1: INTRODUCTION

Sugar-Sweetened Beverages (SSBs) are liquids sweetened with various forms of added sugar. They are the leading source of calories and added sugar in the American diet (Drewnowski & Rehm, 2014; National Cancer Institute, 2016; Powell et al., 2013). The health and nutrition literature has increasingly identified added sugars and SSBs as a key potential contributor to a host of public health issues including obesity, type 2 diabetes, hypertension, and cardiovascular disease (Johnson et al., 2009; Malik et al., 2010; Vartanian et al., 2007). Concern about these public health crises has recently animated regional and local campaigns to attempt to limit consumption of these items through taxes and other policies. These policy proposals have raised demand for information and research about the drivers and effects SSB and beverage consumption in general.

According to the USDA Economic Research Service, Americans consumed a daily average of 366 calories of added sugars (roughly 7.6 tablespoons) per day in 2014, nearly 84% more than the amount recommended in the 2015-2020 Dietary Guidelines for Americans of 4.2 tablespoons (or 201.6 calories[1]) (Bentley, 2017). SSBs accounted for the largest percent (39%) of any single source of added sugars, with Sodas (25%), Fruit Drinks (11%), Coffee and Tea beverages (7%), and Energy Drinks (3%) topping the list (USDHHS and USDA, 2015).

This research has several specific objectives. First, to document the various methods of categorizing beverage types and to present a new beverage categorization system that can be used in future research. Second, this research aims to lay the

[1] For reference, one tablespoon of sugar is 48 calories. A teaspoon of sugar is 16 calories.

groundwork for predictive models of beverage consumption by testing the significance of a series of independent variables on consumption of specific SSB types. Third, this analysis uses the presented beverage categorization system as part of two analyses: one that examines consumption of beverage subtypes by gender-race-age subcategories in the hope of informing public health campaigns that can target those subgroups; another that examines consumption of beverage subcategories over time in an effort to validate the observation that Americans have been "getting the message" about the dangers of sugary beverages.

CHAPTER 2: BACKGROUND

2.1 Sugar and Sugar-Sweetened Beverages

Sugar can refer to one of several chemical substances generally classified as carbohydrates – chemical substances that the body uses for energy. Along with fiber and starch, sugar is a natural component of most fruits and vegetables. However, sugar differs from fiber and starch in the simplicity of its chemical compositions and the ease with which it can be digested and metabolized. Most commonly, the term "sugar" refers to table sugar – sucrose. It is composed of two chemicals, glucose and fructose. Glucose enters the blood stream and promotes an insulin response which helps cells access the energy and balance blood sugar levels. Fructose, the sweetest-tasting monosaccharide, is the main component that gives fruit and vegetables their palatable taste. Unlike glucose, fructose is metabolized only in the liver and cannot be stored in the blood stream. Generally, when fructose is consumed in its most naturally-occurring forms in fruits and vegetables, the fiber and cellular composition of those foods promote a feeling of satiety and a slower absorption of fructose. Fruits and vegetables also tend to contain more micronutrients that the body needs.

SSBs – also called calorically sweetened beverages, or sugary beverages – are liquids with added sugars. They include regular soda, fruit drinks, energy drinks, sweetened waters, and many coffee and tea beverages (USDHHS and USDA, 2015). Commonly, as in the case with most regular sodas, SSBs are sweetened with high fructose corn syrup, a cheaply synthesized liquid sweetener that was first introduced to

the food and beverage industry in the 1970s. Although there is widespread public concern over the detrimental health effects of high fructose corn syrup in particular (Hyman, 2016; Mawer, 2016), high fructose corn syrup is chemically similar to sucrose and is metabolized similarly by the body (Ricciotti & Hur, 2017; White, 2008). This study considers all kinds of beverages with added sugars and details those beverage types in Chapter 3. Although the beverage categorization system presented in this article includes separate categories for dietary beverages with artificial sweeteners, the analyses in this article focus specifically on those beverages with caloric sweeteners.

2.2 Dietary Recall Data in NHANES

Complete and accurate dietary recall data is essential for nutritional monitoring in the United States. The National Health and Nutrition Examination Survey (NHANES) is by far the most common data source for most nutritional epidemiological research in the United States today. This section addresses common objections and issues with the use of 24-hr dietary recall data – specifically from the NHANES – as the basis for nutritional epidemiological research.

2.2.1 24-hour Dietary Recall as the Best Available Option for Collecting Dietary Information

The three major methods for collecting dietary intake data are food records (FR), food frequency questionnaires (FFQs), and 24-hour dietary recalls (24DR). The first, food records – or dietary journaling – can foster accurate reporting but may lead to

reactivity in respondents that can change their dietary patterns. Also, FRs may be subject to the same issues as 24DR if respondents do not keep their reports in real time (A. F. Subar et al., 2015). As such, FFQs and 24DR are the two major methods for examining respondent dietary intake patterns. FFQs are questionnaires that solicit respondents for number of consumption instances and approximate amounts of a large number of food items. 24DRs typically solicit respondents for everything they've consumed in the preceding 24 hour period (typically from midnight to midnight).

In a 2001 study that used objective intake biomarkers (doubly labeled water and urinary nitrogen) Subar and colleagues found that the 24-hour dietary recalls had much lower rates of underreporting (9% for men and 7% for women) compared to the FFQs (35% for men and 23% for women). Similarly, in another study that pooled data from 5 large validation studies which used biomarkers to validate energy expenditures, Freedman and colleagues (2014) found that reported energy intake (EI) using 24DR was a better predictor of actual EI than FFQs data and that 24DR produced a lower average rate of underreporting (15%) compared to the rate predicted from FFQs (28%). In a meta-analysis of validation studies examining potassium and sodium intake, Freedman and colleagues noted conclusively that the use of multiple 24DR substantially increased the correlation coefficient between reported versus true intake (Freedman et al., 2014). Their recommendation that multiple 24DR be used whenever possible is echoed by Black (2000a) and Hébert et al. (2014).

Although nutritional epidemiologists would agree that randomized controlled trials (RCTs) are the gold standard for medical research, the generalizability and

usefulness of RCTs has come under scrutiny as of late, as documented in an edition of the journal, *Social Science & Medicine*, which dedicated an entire issue to the topic ("Randomized Controlled Trials and Evidence-based Policy: A Multidisciplinary Dialogue," 2018). RCTs can only focus on a limited number of exposures at a time and may be neither feasible nor generalizable if subjects' eating or physical activity is excessively altered especially over longer time periods (Carey & Stiles, 2016; Hébert et al., 2014).

Although RCTs remain the gold standard when possible, few would argue with the expediency of 24DR when compared with the resource demands of the controlled experiment. In fact, resource and technical constraints are likely to preclude the use of objective measures of energy intake in large observational studies (Goldberg et al., 1991; Mccrory, Hajduk, & Roberts, 2002). Biomarkers protocols like doubly labeled water, urinary nitrogen, or blood carotenoid measurements, require multiple biological sample collections, storage and processing facilities and trained staff – not to mention the additional burden on study participants. Notably, as Davy & Estabrooks (2015) remark, these biomarkers can provide useful information on dietary components such as energy intake, protein intake, and fruit/vegetable intake, but cannot provide information about specific food items consumed. For that, it seems that the best bet for nutritional research is self-reported data. As noted by the 2015 American Dietary Guidelines Advisory Committee, "…repeated 24-hour recalls remain the backbone of dietary assessment and monitoring." (2015).

The Automated Multiple Pass Method (AMPM) for dietary recall has been the method of dietary recall used in HNAHES since 2002. The AMPM is a computerized system that includes 5 steps with multiple passes designed to enhance complete and accurate food recall (USDA ARS, 2016). The AMPM has been validated in a large study to collect accurate group energy intake of adults (Moshfegh et al., 2008) and has been shown to approximate total energy intake in smaller group studies as well (Blanton et al., 2006; Rumpler et al., 2008).

2.2.2 Addressing Controversy Around the Validity of 24-hour Self Reported Dietary Intake Data

Recent highly publicized work has called the validity of self-reported dietary intake into question and has found physiologically implausible reporting rates to be as high as 67.3% for women and 58.7% for men (Archer, Hand, & Blair, 2013; Ioannidis, 2013). According to the analysis conducted by these authors, this means that reported energy intake is "incompatible with survival" for a majority of reporters (Archer et al, 2013). However, as Black and Goldberg note, although reported EI may not be representative of habitual intake, it can still serve as a valid estimate over the period of measurement (Black, 2000; Goldberg et al., 1991). In response to the publication from Archer and his colleagues, several response articles were published by established nutritional epidemiologists that admitted – as is already well known – that underreporting is a serious and known problem and that careful researchers have accounted for it and should continue to do so while understanding the limitations of their findings (Davy &

Estabrooks, 2015; Hébert et al., 2014; Mitka, 2013; Potter, 2015; A. F. Subar et al., 2015).

Subar et al., (2015) note that although reported dietary information is a poor predictor of total energy intake and would be problematic if used in analyses intending to examine the relationship between food intake and health outcomes, self-reported dietary intake is still a very useful starting point for population-wide analyses of the types of foods being consumed. As it is, those studies that have examined consumption of SSBs by subpopulation (see Table 2) follow a common procedure of considering data from all respondents (including under reporters) and still consistently find that subjects are consuming excessive amounts of added sugar. As such, we can infer that the problem of excessive SSB consumption is, if anything, understated by these analyses and that large datasets from representative populations such as the NHANES may still be an appropriate starting point to understand the extent of problems stemming from overconsumption of certain food items.

It should be noted that the common procedure in analyzing consumption trends of beverages and beverage types is to include all respondents and only one 24hr dietary recall. This was the case for all of the 10 studies identified in the review of literature on beverage categorization in Table 2. However, Hébert et al., (2014) and Black (2000a) note, analysis that attempts to shed light on habitual intake is improved by including multiple days of dietary recall. Consistent with this, this analysis includes two days of dietary recall data.

The analyses included in this work are therefore consistent with the large body of nutritional epidemiological research in considering the entire sample of NHANES respondents. The reader should bear in mind that these findings serve only as a starting point for future analysis and should not be taken as indicative of usual intake.

2.2.3 The National Health and Nutrition Examination Survey

The NHANES dataset is one of the most comprehensive datasets collected about the health and nutrition of Americans and is commonly used in dietary research. The respondents for each cross-sectional NHANES cycle are selected as part of a nationally representative multistage probability cross-sectional sampling of the civilian noninstitutionalized US population. The data used for this analysis consists of four different NHANES collection cycles: 2007-08, 2009-10, 2011-12 and 2013-14. Data collection was approved by the National Center for Health Statistics Institutional Review Board (CDC: National Center for Health Statistics, 2017). Publically available federal data like the NHANES is exempt from human subject review at the University of Vermont. This study examines those 29,188 respondents who did not report consuming breast milk and provided 2 days' worth of reliable dietary recall interviews. "Day 1" data covers all foods consumed within the 24-hour period (midnight to midnight) preceding the interview and was conducted in-person at a mobile examination unit; "Day 2" data, was collected between 3 and 10 days after the Day 1 interview over the telephone. Trained staff conducted the interviews with a computer-assisted system that included a

multiple-pass protocol with standardized probes (Blanton, Moshfegh, Baer, & Kretsch, 2006).

Sampling weights are provided for respondents who completed both days of the dietary interview. Day 1 weights are calculated per respondent to account for unequal probabilities of target subpopulation selection, make adjustments for bias resulting from nonresponders within a given subpopulation, and stratify respondents to match with U.S. Census estimates to improve accuracy (Mirel et al., 2013). The weighting variable used for 2-day dietary recall are based on the 1-day weights. The 2-day weights are further adjusted to account proportion of weekend and weekday responses, since in practice, most MEC interviews are conducted on the weekend when diets may be different (CDC, 2015). Respondents who did not have a valid dietary recall status (i.e. who did not complete the first 4 steps of the AMPM interview) for either day 1 or day 2 were not included. This analysis was unique among studies of its kind because it included the average consumption between the day 1 and day 2 dietary recall (CDC/National Center for Health Statistics, 2018). Table 1 provides summary statistics of selected demographic and response variables for all respondents using the 2-day weights to reflect the total number of respondents represented.

Table 1. Weighted summary statistics for selected demographic and response variables for combined NHANES 2007-08, 2009-10, 2011-12, and 2013-14

Variable	Count	Proportion of Total
Gender (N= 295,578,095)		
Male	142,683,561	48.3%
Female	152,894,534	51.7%
Age (N= 295,578,095)		
2 to 5	15,923,249	5.4%
6 to 11	24,340,641	8.2%
12 to 19	33,532,537	11.3%
20 to 39	81,517,518	27.6%
40 to 59	84,200,051	28.5%
60+	56,064,099	19.0%
Poverty Income Ratio (N= 275,043,016)		
<130%	70,638,143	25.7%
130% - 185%	29,280,749	10.6%
186% - 250%	28,986,277	10.5%
251% - 350%	36,784,578	13.4%
>350%	109,353,269	39.8%
Educational Attainment of Household Reference Person (N= 285,844,606)		
Less than high school	51,235,074	17.9%
High school graduate/GED	62,878,008	22.0%
Some college or more	171,731,524	60.1%
Cohabitation Status of Household Reference Per		
Married or living with partner	200,148,020	68.7%
Widowed, Divorced, Separated	54,337,686	18.7%
Never Married	36,743,965	12.6%
Race (N= 295,578,095)		
Mexican American	29,943,120	10.1%
Other Hispanic and Other Race	37,833,345	12.8%
Non-Hispanic White	191,931,391	64.9%
Non-Hispanic Black	35,870,238	12.1%
Household Food Insecurity (N= 293,567,347)		
Full Food Security	221,790,979	75.6%
Marginal Food Security	25,742,617	8.8%
Food Insecure	29,364,139	10.0%
Very Food Insecure	16,669,612	5.7%
BMI (N= 295,578,095)		
Underweight (BMI <18.5)	39,901,139	13.5%
Normal (BMI 18.5-24.9)	89,404,329	30.2%
Overweight (BMI 25-29.9)	81,167,069	27.5%
Obese (BMI >= 30)	85,105,557	28.8%
Weight Loss Intention (N= 295,503,417)		
Currently trying to lose weight	37,998,763	12.9%
Not currently trying to lose weight	257,504,654	87.1%
Average Reported Calorie Intake (N= 295,578,095)		
<=1400	59,047,783	20.0%
<=1800	68,122,284	23.0%
<=2400	90,007,707	30.5%
> 2400	78,400,320	26.5%
Survey Year (N= 295,578,095)		
2007-2008	72,136,751	24.4%
2009-2010	73,189,228	24.8%
2011-2012	74,766,029	25.3%
2013-2014	75,486,086	25.5%

Note: Individuals less than 2 years of age and individuals with unreliable or incomplete dietary intake data were excluded. Counts and Ns in the table above represent the weighted total of represented respondents.

CHAPTER 3: BEVERAGE CATEGORIZATION SYSTEMS IN THE LITERATURE

3.1 Review of Existing Beverage Categorization Systems

A literature review was conducted on recently published articles that included a comprehensive beverage categorization system and examined beverage consumption by age, sex, and race/ethnicity. English-language articles published after 1999 (the first year of the Continuous NHANES) to the present day were identified via Google Scholar and a database search engine that included MEDLINE, ProQuest, and the Health Reference Center Academic. Key words such as "beverages", "sugar-sweetened", "sugary", "consumption", "subpopulation", "race/ethnicity", "categories", "typology", and "trends" were used. All of the included studies employed at least two cycles of NHANES data. The 10 identified studies are summarized in Table 2.

Previous literature has used food and beverage categories that were aligned with federal dietary guidelines including the now defunct MyPyramid Food groups (Bachman, Reedy, Subar, & Krebs-Smith, 2008). Several studies utilized the "University of North Carolina-Chapel Hill Good Grouping System", a grouping of 74 total descriptive and nutrient-based food subgroups including 7 distinct beverage types (Nielsen & Popkin, 2004; Popkin & Nielsen, 2003; Popkin, Siega-Riz, & Haines, 1996) which is not available in detail (personal communication). In more recent study, Drewnowski & Rehm (2014) used categories originally developed by the National Cancer Institute (National Cancer Institute, 2016) to analyze consumption of added sugars, but did not conduct

analyses specifically by beverage subtype. To date, the more comprehensive food grouping system is the “What We Eat In America Food Categories” (WWEA Categories) which were originally developed by the Food Surveys Research Group of the USDA in 2013 for use with the Food and Nutrient Database for Dietary Studies (FNDDS) that is used in the NHANES (Rhodes, Adler, Clemens, & Moshfegh, 2017). This system has more than 150 types of food categories including 31 distinct beverage types.

Table 2. Summary of reviewed studies conducting subpopulation analyses on beverage consumption trends from 1999 to present

Study	Beverage Types	Beverage Categories		Definition of SSBs / Other Notes
Murphy & Douglass 2007	14	• regular soft drinks • fruit drinks • presweetened tea • sports drinks • diet drinks • fruit/vegetable juices • plain milk	• flavored milk • milk-based-beverages • coffee • tea • meal replacement beverages • alcoholic beverages and substitutes • other	regular soft drinks, fruit drinks, presweetened tea
Drewnowski et al., 2013	11	• water • milk (including flavored) • 100% fruit juice • regular fruit drinks • diet fruit drinks • sports/energy drinks	• soda/soft drinks • diet sodas/soft drinks • coffee • tea • alcoholic beverages	examined consumption by specific beverage category in milliliters, not calories. Did not examine SSBs overall in terms of calories. Focused specifically on water consumption.
Bleich, Vercammen, Koma, & Li, 2018	8	• SSBs • 100% juice • diet beverages • milk, flavored milk, milk alternatives	• unsweetened coffee and tea • alcohol • water • other SSBs (including sweetened coffee and tea)	soda, fruit drinks, sports drinks, low calorie drinks and "other" SSBs
Nielsen & Popkin, 2004	7	• coffee and tea • soft drinks • fruit drinks • alcohol	• milk • other milk beverage (with at least 50% milk) • fruit juice	Soft drinks and fruit drinks
Storey, Forshee, & Anderson, 2006	7	• regular carbonated soft drinks • diet carbonated soft drinks • fluid milk	• coffee • tea • regular fruit drinks/ades • diet fruit drinks/ades	Not defined. Analyzed only specific beverage categories and not SSBs in aggregate.
Bleich, Wang, Wang, & Gortmaker, 2009	6	• SSBs • 100% juice • diet beverages	• milk (including flavored milk) • coffee or tea • alcohol	Included "soda, sport drinks, fruit drinks and punches, low-calorie drinks, sweetened tea, and other sweetened beverages"
Ogden, Kit, Carroll, & Park, 2011	5	• fruit drinks • sodas • energy drinks	• sports drinks • sweetened bottled waters	Specific beverage categories were not analyzed. Only defined SSBs were analyzed in aggregate. Other non-SSBs such as 100% juice, milks, unsweetened coffee and tea drinks were not included in analysis.
Han & Powell 2013	4	• regular soda • fruit drinks (non-diet non-100% juice drinks) • non-diet sports and energy drinks	• non-diet nonmilk-based beverage concentrates, nondiet sugar-sweetened coffee and tea products and all other SSBs	Only defined SSBs (see 4 categories at left) were included in analysis. Other non-SSBs such as 100% juice, milks, unsweetened coffee and tea drinks were not included in analysis.
Kit, Fakhouri, & Park 2013	4	• Soda • Fruit Drink	• Sweetened Coffee/Tea • Sport or Energy	Specific beverage categories were not analyzed. Only defined SSBs were analyzed in aggregate. SSBs included "…soda, fruit drinks (including sweet- ened bottled waters and fruit juices and nectars with added sugars), sports and energy drinks, sweetened coffees and teas, and other SSBs"
Piernas, Ng, & Popkin, 2013	2	• calorically sweetened beverages	• non- or low-calorically sweetened beverages (using aspertame, sucralose, stevia, etc.)	Did not consider SSBs as aggregated category. Included only calorically sweetened beverages, low/no calorie sweetened beverages

Note. All studies above used NHANES reported dietary intake as a primary data source.

3.2 A New Beverage Categorization System

This analysis proceeded with a beverage categorization typology that contains 23 primary beverage types which roughly match the WWEIA categories. We refer to this system as the Synthesized Beverage Categorization System (SBCS). A summary of these primary beverage types are included in Table 3. This system includes several subcategories not previously considered in the literature. For example, regular Unsweetened Teas (with no sweeteners) are distinguished from Diet Tea (with non-caloric sweeteners) and Sweetened Tea Beverages (with caloric sweeteners). A similar distinction is made between Juices, Diet Juice Drinks, and Juice Beverages. In another case, regular Coffee Drinks (no caloric sweeteners) are distinguished from Coffee Beverages (with caloric sweeteners). In the case of Milk-based beverages, categories are not delineated by the presence of caloric sweeteners, but by the type of milk used – either Low Fat (skim or 1%) or Higher Fat (whole or 2%). Flavored Low Fat Milk and Flavored Higher Fat Milk beverages are similarly distinguished. Finally, Water is broken down into Water (including plain tap and bottled water), Flavored Water (with caloric sweeteners) and Water Beverages (with no caloric sweeteners). Calorically sweetened beverages are defined as any beverage belonging to one of the following categories: Coffee Beverages, Energy Drinks, Flavored Waters, Juice Beverages, Flavored Milk, Low Fat Flavored Milk, Sweetened Nut Milk, Soda, and Sweetened Tea. These beverage categories are summarized in Table 3.

This beverage categorization system identifies 9 subtypes of sugar-sweetened beverages: Coffee Beverages, Energy Drinks, Flavored Milks, Flavored Waters, Fruit

Drinks, Low Fat Flavored Milks, Soda, Sweetened Non-Dairy Beverages, and Sweetened Tea. It is worth noting that the literature does not typically include flavored milk and low fat flavored milks as SSBs because of the fact that milk also contains important nutrients. However, the contributions of these milk items – both in terms of calories and added sugars – can be substantial and will be considered in this analysis to provide a full context of SSB consumption.

Table 3. The Synthesized Beverage Categorization System - Beverages Categorized as SSBs

Beverage Category	Corresponding WWEIA Categories	Description
Coffee Beverage	Coffee	Coffee beverages containing caloric sweetners. Includes beverages that are "flavored", "sweetened" or "pre-sweetened". Includes cappuccinos, lattes, and café mochas.
Energy Drink	Sports and Energy Drinks	Energy drinks that contain added sugars. Includes Gatorade, Powerade, and "reconstituted" energy beverages.
Flavored Milk	Flavored Milk - Whole, Flavored Milk - Reduced Fat	Whole or 2% milk combined with a flavoring agent including syrups or powders. Includes any kind of chocolate beverage, hot cocoa made with milk, and any kind of ready-to-drink flavored milk.
Flavored Water	Sports and Energy Drinks	Water beverage with caloric-sweetner including "low-calorie" sweetners. Includes "fluid replacement" beverages.
Juice Drink	Fruit Drinks	Non-100% juice drinks with caloric sweetners. Includes carbonated juice beverages, any kind of fruit "nectar", and "reconstituted" beverage mixes.
Low Fat Flavored Milk	Flavored Milk - Lowfat, Flavored Milk - Nonfat	Skim or 1% milk combined with a flavoring agent including syrups or powders. Includes any kind of chocolate beverage, hot cocoa made with milk, and any kind of ready-to-drink flavored milk.
Soda	Soft Drinks	Carbonated beverages with caloric sweetners.
Sweetened Non-Dairy Beverage	Milk Substitutes	Non-dairy-based milk such as soy, almond, rice, cashew, or coconut milk. Includes flavored-non dairy-milk mixes. Also includes rice milk which has no added sugars.
Sweetened Tea	Tea	Tea beverages with caloric sweetners. Includes "pre-sweetened". All pre-bottled tea beverages are included in this category.

Beverage Category	Corresponding WWEIA Categories	Description
Coffee Beverage	Coffee	Coffee beverages containing caloric sweetners. Includes beverages that are "flavored", "sweetened" or "pre-sweetened". Includes cappuccinos, lattes, and café mochas.
Energy Drink	Sports and Energy Drinks	Energy drinks that contain added sugars. Includes Gatorade, Powerade, and "reconstituted" energy beverages.
Flavored Milk	Flavored Milk - Whole, Flavored Milk - Reduced Fat	Whole or 2% milk combined with a flavoring agent including syrups or powders. Includes any kind of chocolate beverage, hot cocoa made with milk, and any kind of ready-to-drink flavored milk.
Flavored Water	Sports and Energy Drinks	Water beverage with caloric-sweetner including "low-calorie" sweetners. Includes "fluid replacement" beverages.
Fruit Drink	Fruit Drinks	Non-100% juice drinks with caloric sweetners. Includes carbonated juice beverages, any kind of fruit "nectar", and "reconstituted" beverage mixes.
Low Fat Flavored Milk	Flavored Milk - Lowfat, Flavored Milk - Nonfat	Skim or 1% milk combined with a flavoring agent including syrups or powders. Includes any kind of chocolate beverage, hot cocoa made with milk, and any kind of ready-to-drink flavored milk. Includes some beverages with added sugars and some without.
Soda	Soft Drinks	Carbonated beverages with caloric sweetners.
Sweetened Non-Dairy Beverage	Milk Substitutes	Non-dairy-based milk such as soy, almond, rice, cashew, or coconut milk. Includes flavored-non dairy-milk mixes.
Sweetened Tea	Tea	Tea beverages with caloric sweetners. Includes "pre-sweetened". All pre-bottled tea beverages are included in this category.

Table 3 Continued. The Synthesized Beverage Categorization System - Beverages Not Categorized as SSBs

Beverage Category	Corresponding WWEIA Categories	Description
Alcohol	Beer, Wine, Liquors and Cocktails	Any beverage containing alcohol.
Coffee	Coffee	Includes all unsweetened coffees or reconstituted coffees if no other caloric sweetners are added. Includes espresso, macchiato, café con leche and cofee alternatives (e.g. postum, chickory).
Diet Soda	Diet Soft Drinks	Sodas and carbonated beverages with no added caloric sweetners.
Diet Tea	Tea	Teas with non-caloric sweetners.
Energy Drink Without Caloric Sweetners	Diet Sports and Energy Drinks	Energy drinks without caloric sweetners. Includes "sugar-free" and "low calorie" energy beverages.
Juice	Citrus Juice, Apple Juice, Other Fruit Juice, Vegetable Juice	All 100% juice types without caloric sweetners.
Juice Beverage Without Caloric Sweetner	Fruit Drinks, Other Diet Drinks	Non-100% juice drinks made without caloric sweetners. Includes beverages explicitly labeled "diet" and some "light", "low sugar" or "low calorie" beverages.
Low Fat Milk	Milk - Lowfat, Milk - Nonfat	Skim and 1% milk without added sugar.
Milk	Milk - whole	Whole milk, 2% milk, and variants without added sugars.
Mixed Meal Replacement	Nutritional Beverages, Smoothies and Grain Drinks	Mixed meal replacement beverages. Includes smoothies, protein drinks, and ready-to-drink beverages such as "Ensure", "Boost", and "Slim Fast". Some of these beverages include added sugars and some do not.
Tea	Tea	Plain tea with no sweetners.
Unsweetened Non-Dairy Beverage	Milk Substitutes	Unsweetened almond milk - regular and chocolate. All other types of "Nut Milks" contain added sugars.
Water	Tap Water, Bottled Water	Plain water, tap or bottled
Water Beverage	Enhanced or Fortified Water	Water beverage with non-caloric sweetner.

The SBCS also created distinct categories for combination-type beverages. The NHANES includes a distinct code for liquids that are the result of combinations of other items, such as coffee with milk, chocolate milk mixtures from powder, mixed alcoholic drinks, and protein and powder drinks. These combination beverage types are described in Table 4. When considering total calories in a combination, this analysis included all calories from the primary beverage (the beverage used in the largest amount) but only calories from added sugars from any supplementary beverages. For example, some milk

added to black coffee would include all of the calories from the coffee as well as any calories that came from any added sugars in the milk (if added sugars were present).

Table 4. The Synthesized Beverage Categorization System - Combination Beverage Types

Beverage Combination Type	Decription	Examples
Coffee Combination	Any combination beverage that used "Coffee" or "CoffeeDrink" as the primary beverage ingredient.	Coffee with any added sugar, tea, or milk
Juice Combination	Any combination beverage using a Juice, Juice Beverage or Diet Juice Drink as the primary beverage ingredient.	Juice mixtures (orange-cranberry, grape-apple). Smooties with a juice base.
Milk Combination	Any combination beverage using Milk Low Fat Milk, Flavored Milk, or Low Fat Flavored Milk as the primary beverage ingredient.	Chocolate milk from powder
MMR Combination	Any beverage combination using a mixed meal replacement beverage or powder as an ingredient. This does not depend on the beverage used. For example, if a milk, or juice drink was mixed with an MMR nutritional powder, it would be categorized as a MMR Combination beverage.	Protein power drink
Other Combination	Any other combination beverage which used a primary beverage ingredient other than the beverage categories above. This includes Soda, Diet Soda, Sweetened Nut Milk, Unsweetened Nut Milk, Alcohol, Energy Drink, Energy Drink without Caloric Sweetners.	Chocolate beverage mixture with nut milk, mixed alcoholic drinks.
Tea Combination	Any combination beverage that used Unsweetened Tea, Sweetened Tea or Diet Tea as the primary beverage ingredient.	Tea with any added sugar, tea, or milk
Water Combination	Any combination beverage using Water, Water Beverage, or Flavored Water as the primary beverage ingredient.	Water mixed with electrolyte solution

NHANES dietary data provides the total sugar content of any given consumption item. To specifically identify the added sugar content of food items, additional data from the Food Patterns Equivalents Database of the USDA Food Surveys Research Group were used (USDA, 2017). In general, added sugar-containing beverages were categorized as SSBs as long as they were consumed either 1) not in combinations with any other item or 2) in combinations other than beverage combinations. Beverages that did not have added sugars were not SSBs. Any beverage that was used in a beverage combination aggregated all of the calories from all of the ingredients and was considered a “combination” beverage and was categorized according to the primary beverage used – that is, the beverage used in the largest quantity in the combination. This is the only study known to include contributions from beverage combinations with the exception of an analysis conducted by Murphy & Douglass (2007).

After developing the 23 primary beverage types, all FNDDS items from the last four NHANES cycles were coded by the author. Reconciliations were made between study cycles for beverage types whose codes may have changed from cycle to cycle or discontinued from previous cycles.

The particular benefit of the SBCS over alternative systems is that it refers to both the WWEIA food codes and to the Food Patterns Equivalents Database. This is a large improvement over other systems that code beverages by their "Food Description" contained in the FNDDS alone because the WWEIA food codes are created by nutritionists based on usage and nutrient content (USDA Food Surveys Research Group, 2018). Additionally, coding schemes based on the food description alone can leave out important details, such as the added sugar content of the beverage.

CHAPTER 4: CONSUMPTION OF MAJOR SSB SUBTYPES BY SELECTED CHARACTERISTICS

Literature that has examined consumption patterns of sugar-sweetened beverages by demographic subpopulation has analyzed data primarily by examining consumer consumption patterns themselves. This chapter lays the groundwork for predictive models of beverage consumption by testing the significance of a series of independent variables on consumption of specific SSB types. These variables and their levels are given in Table 1 and are justified in the next section.

4.1 Variable Selection

Gender

This is a standard dependent variable by which means should be compared because of the metabolic differences between men and women (USDHHS and USDA, 2015).

Age Category

Obviously, metabolism functioning can vary widely depending on a respondent's age. The age categories employed in this analysis are the same as those used in similar studies conducted by Kit, Fakhouri, & Park (2013); Ogden, Kit, Carroll, & Park, (2011); and Storey, Forshee, & Anderson (2006). These age groupings are shown below in Table 5 along with their commonly used group title. "Children" refers to individuals ages 2 to 19 while "Adults" refers to individuals 20 and older.

Table 5. Common Age Groupings and Age Group Titles

Children/Adults	Age Range	Common Group Title
Children	2 to 5	Toddlers
	6 to 11	Young Children
	12 to 19	Adolescents
Adults	20 to 39	Young Adults
	40 to 59	Middle-Aged Adults
	60+	Seniors

Poverty Income Ratio

Most analyses of NHANES dietary data employ the Household Poverty Income Ratio as the metric for household income. This metric is more useful than household income because it accounts for the size of the household and can be compared across the 7-year span of the NHANES used in this analysis. The US Department of Health and Human Services produces poverty guidelines which is used to calculate this ratio. The threshold of 130% of the official poverty level is common in the literature (Bleich et al., 2009; Reedy & Krebs-Smith, 2010), as it represents the income threshold for SNAP benefits. The threshold of 185% is also commonly employed (Dodd, Briefel, Cabili, Wilson, & Crepinsek, 2013; Piernas, Ng, & Popkin, 2013; Reedy & Krebs-Smith, 2010) because it is the eligibility threshold for WIC and the National School Lunch Program (CDC, 2015). Piernas et al. (2013) and Drewnowski & Rehm (2014) used similar groupings for higher income categories.

Educational Attainment

The educational coding scheme used in this analysis – less than high school, high school graduate or GED recipient, and some college or more – is consistent with

Bleich et al., (2009). Han & Powell (2013) used an even simpler categorization system of low education (high school or less) and high education (some college or more). Popkin, Siega-Riz, & Haines (1996) similarly used an educational attainment level of less than high school as an indicator of low socio-economic status.

Cohabitation Status

This is the marital status of the household reference person. The household reference person is the first member of the household 18 years of age or older who owns or rents the residence where the household members reside. None of the existing literature consulted for this analysis has specifically examined the relationship between this variable and consumption of various SSBs. However, literature that deals with the link between food insecurity and obesity does consistently reveal that there is a strong relationship between obesity and being a mother with children. This relationship is especially pronounced for single mothers with children (Frongillo & Bernal, 2014; Martin & Lippert, 2012). The hypothesis that the stresses associated with child care contribute to suboptimal dietary patterns for the caregiver has received support in one of the major studies that examined the topic (Martin & Lippert, 2012). A good deal of research has examined the relationship between the presence of life stressors and consumption of high-sugar "comfort" foods (Tomiyama, Dallman, & Epel, 2011), but significantly less has been researched specifically about the role of SSBs in adaptive responses to stress. One study conducted in Sweden found that consumption of SSBs was linked with more "external" eating – eating in response to visual, olfactory, or gustatory

cues – as opposed to emotional eating or eating for comfort (Elfhag, Tynelius, & Rasmussen, 2007). Another study conducted in Norway found that women who were not married or cohabitating with partners were more likely to consume SSBs (Henriksen, Torsheim, & Thuen, 2014).

Race/Ethnicity

Until the 2011-2012 NHANES data collection cycle, the only categories for race/ethnicity were Mexican American, Other (Non-Mexican) Hispanic, Non-Hispanic White (hereafter White), Non-Hispanic Black (hereafter Black), and Other Race including Multi-Racial. Although the 2011-2012 data collection cycle included an additional category for Non-Hispanic Asian, this variable was not included to maintain consistency between the NHANES data collection cycles used in this analysis.

BMI Category

Body Mass Index (BMI) is the weight divided by the squared height of an individual. There are serious problems with using BMI as a measurement of obesity. Given that the relationship between height and weight is cubic as opposed to a square, BMI systematically overestimates the obesity of tall people (Nordqvist, 2017). Despite this and other issues with BMI as a measure of obesity (Rothman, 2008), BMI remains a common measurement in research related to SSB consumption patterns, especially for adults (Bleich et al., 2009; Murphy & Douglass, 2007). BMI is not an accurate comparison for children because of the wide range of differences in height and weight

ratios. Therefore, since the 2011-12 NHANES collection cycle, NHANES has included a new variable that categorizes children's weight profiles according to their percentile of their BMI in an age-matched peer group. Calculating these percentiles for the 2007-08 and 2009-10 NHANES cycles is out of the scope of this analysis and will therefore be done for adults only and not children.

Reported Total Average Daily Calories

None of the literature consulted for this analysis used a total daily calorie consumption categorization system. The Institute of Medicine (IOM) publishes a Dietary Reference for Intakes for Energy which is used in federal nutrition research guidance (USDHHS and USDA, 2015). In general, dietary guidelines are published based on 2,000 calorie diets. As a point of reference, the IOM only recommends diets of less than 1,400 calories for children under the age of 10 who are sedentary. Diets of less than less than 1,800 calories are recommended only for adolescents. Diets of 2,400 calories or greater are only recommended for young adult males and highly active females. Given that the NHANES data collect *reported* caloric intake, which is known to be consistently below actual intake for most respondents (Goldberg et al., 1991) and that there is a huge variety individuals' caloric needs based on their metabolism and activity level, it would be difficult to construct calorie intake categories that would capture meaningful differences in respondents without including the mediating effects of other variables.

Food Security Category

Food security is commonly assessed in the SSB literature with the Household Food Security Questionnaire (HFSSQ) (Bickel, Nord, Price, Hamilton, & Cook, 2000; Frongillo & Bernal, 2014). This questionnaire is scored on a scale of 0 to 10 for households without children and 0 to 18 for households with children. The questionnaire includes questions about the frequency of food insecurity events and experiences and asks the extent to which respondents agree to statements such as "In the last 12 months, we worried whether our food would run out before we got money to buy more" or "In the last 12 months, we couldn't afford to eat balanced meals." Scores from this questionnaire are grouped into four subcategories: Fully food secure, marginally food secure, food insecure and very food insecure (Bickel et al., 2000; Frongillo & Bernal, 2014).

4.2 Statistical Approach

Statistical analysis was conducted in SAS Version 9.2 (SAS Institute Inc.) using procedures specifically designed for survey data. The dependent variables were the measurements for the total calories and total teaspoon equivalents of added sugars from the eight SSB sub-types as well as four types of combination beverages thought likely to include high amounts of added sugar (Coffee Combinations, Tea Combinations, Milk Combinations and Juice Combinations). Adjustments to account for the possibility of false positives from multiple comparisons were made using the Tukey-Kramer method, with a significance level at $P<0.01$. Results are provided in Tables 6 to 22.

4.3 Results

These tables have been produced to lay the groundwork for future studies that may be interested in examining the roles of these variables in mediating consumption of various SSBs. Tables 6 through 22 are included as infographics to aid in interpretation. The blue bars in the body of the tables are bar graphs over which the cell values have been superimposed. These are scaled to the maximum value in the 'All SSB' category to serve as a point of reference. The 'Pct of total intra-group comparisons significant' is a measure of the total intra group comparisons that are different from one another as a percentage of the total possible intra-group differences. For example, a category with four subgroups like Food Insecurity would have 6 pairwise comparisons in total. A percentage of 16.7 would indicate that only one pair of the 6 subgroups had means that were significantly different. A percentage of 66.7 would indicate that 4 pairs of the 6 had means that were significantly different. This is a rudimentary measure of the extent of the differences between groups and is included as an aid to interpretation.

The following sections will discuss findings from each variable.

ANOVA TABLES FOR CHILDREN (Individuals age 2 -19)

Table 6. Average reported calorie intake for sugary beverage subcategories for children by age category

Age Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
2 to 5	114.1228^{C} (5.8301)	0.065^{B} (0.0348)	2.8964^{C} (0.473)	0.1413^{B} (0.0496)	36.1754^{B} (1.6796)	43.9051^{A} (4.9583)	7.7088^{B} (1.3457)	3.5399^{A} (1.0926)	16.4327^{C} (1.3875)	3.2583^{C} (0.4421)	0.3581^{B} (0.0869)	0.3115^{C} (0.0747)	15.2749^{A} (1.6251)	7.8862^{A} (1.024)	39.8867^{A} (2.6353)
6 to 11	172.5^{B} (4.3118)	0.3181^{B} (0.1223)	8.2905^{B} (0.8071)	0.4157^{B} (0.1224)	44.3471^{A} (1.685)	49.8787^{A} (2.2312)	11.7377^{A} (1.3965)	1.4231^{A} (0.3693)	48.568^{B} (2.4219)	7.5211^{B} (1.0001)	0.7801^{B} (0.1784)	0.777^{B} (0.1635)	5.5241^{B} (0.6055)	2.3734^{B} (0.386)	42.9818^{B} (1.6947)
12 to 19	215.6466^{A} (5.6616)	2.4591^{A} (0.4685)	19.7198^{A} (3.024)	1.19^{A} (0.2382)	36.7181^{B} (1.8846)	26.8567^{B} (2.4308)	6.7716^{B} (0.8614)	0.9785^{A} (0.2375)	100.7187^{A} (4.3103)	20.234^{A} (1.7918)	4.5921^{A} (0.6086)	1.9558^{A} (0.3797)	3.9498^{B} (0.582)	2.1502^{B} (0.5913)	35.7148^{C} (1.8832)
Pct of total intra-group comparisons significant	100.0%	66.7%	100.0%	66.7%	66.7%	66.7%	66.7%	0.0%	100.0%	100.0%	66.7%	100.0%	66.7%	66.7%	100.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 7. Average reported calorie intake for sugary beverage subcategories for children by gender

Gender Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Male	204.1813^{A} (5.4304)	0.6867^{A} (0.1835)	17.6243^{A} (2.8357)	0.571^{A} (0.1447)	39.7001^{A} (1.5626)	42.8573^{A} (2.9921)	9.648^{A} (1.1611)	1.9173^{A} (0.399)	79.4427^{A} (3.7041)	11.734^{A} (1.1682)	2.1476^{A} (0.3523)	1.0676^{A} (0.2052)	7.6435^{A} (0.8184)	3.5746^{A} (0.6402)	47.6117^{A} (1.963)
Female	154.4774^{B} (3.801)	1.7942^{B} (0.4459)	6.9383^{B} (0.7369)	0.8477^{A} (0.1924)	38.5259^{A} (1.6136)	33.3302^{B} (1.7961)	7.5604^{A} (0.979)	1.4348^{A} (0.3894)	51.0143^{B} (2.6099)	13.0317^{A} (1.3819)	2.6989^{A} (0.4692)	1.359^{A} (0.2948)	6.171^{A} (0.7203)	3.3466^{A} (0.3771)	38.9798^{B} (1.3713)
Pct of total intra-group comparisons significant	100.0%	100.0%	100.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 8. Average reported calorie intake for sugary beverage subcategories for children by poverty income ratio category

Poverty Income Ratio Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
<130%	189.7869^{A} (5.7485)	1.4841^{A} (0.2375)	10.6107^{A} (1.535)	0.7757^{A} (0.2177)	45.6246^{A} (2.0212)	39.9959^{A} (2.7254)	7.5813^{A} (0.962)	0.7851^{A} (0.1499)	70.8479^{A} (4.0432)	12.0815^{A} (1.3479)	2.7232^{A} (0.4155)	1.0181^{A} (0.1867)	8.0104^{A} (0.9658)	3.8588^{A} (0.4972)	48.1503^{A} (2.0226)
130% - 185%	182.4365^{A} (7.2025)	0.5711^{AB} (0.2642)	8.6405^{A} (2.2788)	0.2374^{A} (0.1087)	45.8169^{AB} (4.2164)	39.6704^{A} (4.1293)	8.0514^{A} (1.9863)	0.9589^{A} (0.3924)	67.4217^{A} (5.3644)	11.0682^{A} (1.7458)	3.1465^{AB} (0.8447)	2.1213^{A} (0.649)	7.4836^{A} (1.4245)	3.6086^{A} (0.83)	47.5474^{AB} (4.6275)
186% - 250%	177.8792^{A} (9.612)	0.3917^{B} (0.2006)	8.5521^{A} (1.8678)	0.8303^{A} (0.3093)	37.3496^{ABC} (3.2381)	34.4456^{A} (4.2556)	6.0162^{A} (1.3935)	1.3559^{A} (0.4888)	69.2458^{A} (5.3562)	10.692^{A} (1.8825)	2.471^{AB} (0.9366)	0.5374^{A} (0.2194)	7.0737^{A} (1.7514)	5.0886^{A} (2.1468)	45.7615^{AB} (4.3748)
251% - 350%	182.599^{A} (8.6344)	1.2485^{AB} (0.7009)	13.7481^{A} (2.4115)	0.882^{A} (0.3338)	33.8259^{BC} (2.6415)	40.2029^{A} (4.5092)	9.4937^{A} (2.0216)	1.1599^{A} (0.7042)	67.654^{A} (5.9809)	14.384^{A} (3.9358)	0.8443^{B} (0.2497)	1.2103^{A} (0.4229)	6.8186^{A} (1.4591)	2.7081^{A} (0.5219)	40.0879^{AB} (4.0503)
>350%	170.1224^{A} (8.8072)	1.1559^{AB} (0.5174)	16.7268^{A} (4.5466)	0.6973^{A} (0.2482)	32.4138^{C} (1.9841)	36.4606^{A} (4.3354)	10.2804^{A} (1.8938)	3.6386^{A} (1.1119)	57.3098^{A} (4.487)	11.4394^{A} (1.9101)	2.1236^{AB} (0.472)	1.3713^{A} (0.5369)	5.7316^{A} (0.9742)	2.887^{A} (0.5589)	35.9924^{B} (1.7301)
Pct of total intra-group comparisons significant	0.0%	10.0%	0.0%	0.0%	30.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.0%	0.0%	0.0%	0.0%	10.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 9. Average reported calorie intake for sugary beverage subcategories for children by educational attainment of household reference person

Educational Attainment of Household Reference Person Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Less than high school	189.2696^{A} (4.4173)	1.2148^{A} (0.2565)	9.6227^{A} (1.2419)	0.4267^{A} (0.1289)	42.9817^{AB} (2.6781)	36.4775^{A} (2.8389)	6.7468^{A} (0.9391)	0.5751^{B} (0.2256)	80.1883^{A} (4.2632)	11.036^{A} (0.9283)	2.8479^{A} (0.4432)	0.9773^{A} (0.184)	7.64^{A} (0.9762)	4.4302^{A} (0.7495)	48.1463^{A} (2.3545)
High school graduate/GED	185.1441^{A} (4.6417)	1.0311^{A} (0.4654)	11.4948^{A} (1.6611)	0.5912^{A} (0.1774)	44.0259^{A} (2.5685)	40.038^{A} (2.7706)	8.4304^{A} (1.4929)	0.4819^{B} (0.1507)	67.8555^{B} (4.5701)	11.1954^{A} (1.7414)	2.317^{A} (0.4321)	1.0285^{A} (0.2866)	6.381^{A} (1.1193)	3.5156^{A} (1.1807)	42.8722^{A} (2.4019)
Some college or more	174.8708^{A} (5.5414)	1.192^{A} (0.3325)	13.8513^{A} (2.4226)	0.8476^{A} (0.1948)	36.5707^{B} (1.4967)	37.7627^{A} (2.8109)	9.5187^{A} (1.177)	2.5016^{A} (0.5009)	59.5501^{B} (3.0126)	13.0762^{A} (1.6239)	2.3633^{A} (0.4644)	1.2204^{A} (0.3125)	6.7285^{A} (0.6869)	3.2533^{A} (0.3515)	42.4245^{A} (1.5855)
Pct of total intra-group comparisons significant	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	66.7%	66.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 10. Average reported calorie intake for sugary beverage subcategories for children by cohabitation status of household reference person

Cohabitation Status of Household Reference Person Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Married or living with partner	171.5523^{B} (4.5189)	1.1345^{A} (0.2483)	12.752^{A} (1.9141)	0.5387^{A} (0.1067)	35.0544^{C} (1.3132)	39.225^{A} (2.2)	9.3891^{A} (1.086)	1.9742^{A} (0.395)	60.7028^{B} (2.9192)	10.7816^{B} (0.9878)	2.3799^{A} (0.3699)	1.1289^{A} (0.1731)	7.4692^{A} (0.7074)	3.6994^{A} (0.4548)	42.559^{B} (1.4795)
Widowed, Divorced, Separated	207.2116^{A} (7.1266)	1.7048^{A} (0.5342)	10.0524^{A} (1.3747)	0.7037^{A} (0.29)	45.705^{B} (2.488)	36.2395^{A} (4.1256)	6.9737^{A} (1.5211)	1.0338^{AB} (0.3424)	84.7393^{A} (5.3608)	20.0595^{A} (3.7742)	2.6733^{A} (0.6384)	1.6931^{A} (0.8397)	5.9112^{A} (1.4355)	2.4424^{A} (0.5318)	42.5893^{B} (2.9994)
Never Married	190.8568^{AB} (9.7051)	0.7928^{A} (0.3329)	12.5617^{A} (3.5914)	1.5881^{A} (0.8789)	62.3519^{A} (4.664)	37.5127^{A} (3.8853)	5.8886^{A} (1.3953)	0.4623^{B} (0.1557)	60.066^{B} (5.6026)	9.6328^{AB} (1.7215)	2.3351^{A} (0.6613)	0.8955^{A} (0.3068)	5.5651^{A} (1.017)	3.7241^{A} (0.8615)	51.861^{A} (2.7728)
Pct of total intra-group comparisons significant	33.3%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	33.3%	66.7%	33.3%	0.0%	0.0%	0.0%	0.0%	66.7%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 11. Average reported calorie intake for sugary beverage subcategories for children by race/ethnicity category

Race Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Mexican American	167.3815^{AB} (6.0483)	1.2592^{A} (0.3296)	9.0821^{A} (0.8564)	0.6121^{A} (0.202)	40.1752^{B} (1.9283)	38.2085^{A} (2.3622)	6.6483^{A} (0.9245)	0.868^{B} (0.3206)	63.1108^{AB} (3.5995)	7.4173^{B} (1.0394)	1.945^{A} (0.3393)	1.2146^{A} (0.2544)	10.8944^{A} (1.2769)	5.1979^{A} (0.8677)	50.0874^{A} (2.4659)
Other Hispanic and Other Race	154.7588^{B} (5.9635)	1.4061^{A} (0.5047)	6.2293^{B} (0.9226)	0.9396^{A} (0.2323)	40.9427^{B} (2.708)	40.9847^{A} (3.0086)	8.7215^{A} (1.2264)	2.6444^{A} (0.4936)	44.0134^{C} (2.4391)	8.8771^{B} (1.2126)	2.3166^{A} (0.3819)	1.2973^{A} (0.2869)	12.6688^{A} (1.7817)	3.7909^{A} (0.623)	30.7005^{A} (2.9523)
Non-Hispanic White	188.2858^{A} (6.1438)	1.2223^{A} (0.3123)	15.8584^{A} (2.5154)	0.6393^{A} (0.1855)	29.8636^{C} (1.6667)	39.3574^{A} (3.1059)	9.9555^{A} (1.4405)	1.8042^{AB} (0.4932)	74.6369^{A} (4.2311)	14.9481^{A} (1.717)	2.6213^{A} (0.4953)	1.2847^{A} (0.3249)	5.1818^{B} (0.6744)	3.057^{A} (0.6195)	35.9898^{B} (1.7067)
Non-Hispanic Black	182.9391^{A} (5.8476)	1.0955^{A} (0.5228)	8.0617^{AB} (1.989)	0.8402^{A} (0.3209)	72.1656^{A} (3.1794)	30.3659^{A} (2.5574)	5.2841^{A} (1.2589)	1.0333^{B} (0.2547)	53.0756^{BC} (3.1429)	11.0172^{AB} (1.2136)	2.237^{A} (0.5678)	0.8415^{A} (0.1854)	3.7215^{B} (1.0282)	2.9225^{A} (0.4692)	57.452^{A} (2.3886)
Pct of total intra-group comparisons significant	33.3%	0.0%	33.3%	0.0%	83.3%	0.0%	0.0%	33.3%	50.0%	33.3%	0.0%	0.0%	66.7%	0.0%	50.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 12. Average reported calorie intake for sugary beverage subcategories for children by average reported calorie intake category

Average Reported Calorie Intake Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
<= 1400	98.7755^{D} (3.947)	1.0115^{A} (0.372)	5.879^{B} (0.9735)	0.7671^{A} (0.2512)	24.9942^{C} (1.7166)	19.8688^{C} (1.5495)	5.6494^{B} (0.8957)	1.4856^{A} (0.7113)	30.7174^{D} (2.224)	8.4027^{B} (1.7424)	1.3265^{A} (0.2913)	0.6285^{A} (0.1524)	6.3684^{A} (0.8079)	3.8151^{A} (0.5959)	33.3693^{C} (1.4723)
<= 1800	145.2713^{C} (3.7867)	0.6789^{A} (0.1797)	6.514^{B} (0.8442)	0.4257^{A} (0.1499)	35.7731^{B} (1.7055)	34.3599^{B} (2.521)	8.8778^{AB} (1.2762)	1.726^{A} (0.3246)	46.3975^{C} (2.6243)	10.5185^{B} (1.6413)	2.6498^{A} (0.7938)	1.1192^{A} (0.3397)	7.205^{A} (1.0813)	3.4144^{A} (0.4852)	41.8191^{B} (1.847)
<= 2400	200.4697^{B} (6.5142)	1.4965^{A} (0.6074)	11.7973^{A} (1.1894)	0.5676^{A} (0.1611)	43.9347^{A} (2.4617)	49.437^{A} (4.0518)	9.6044^{AB} (1.5692)	1.6813^{A} (0.5711)	69.3805^{B} (4.6086)	12.0704^{B} (1.4777)	2.4485^{A} (0.423)	1.6384^{A} (0.4294)	6.8579^{A} (0.7477)	2.7424^{A} (0.4355)	44.2872^{B} (2.2513)
> 2400	299.3607^{A} (11.7952)	1.9018^{A} (0.5461)	29.8327^{A} (7.0176)	1.2637^{A} (0.3888)	54.4404^{A} (3.4217)	48.8966^{A} (4.1009)	10.4747^{A} (1.4185)	1.8536^{A} (0.6068)	129.9936^{A} (7.5398)	20.7035^{A} (2.8186)	3.4754^{A} (0.801)	1.4123^{A} (0.2827)	7.2926^{A} (1.2889)	4.2364^{A} (1.345)	56.8765^{A} (3.6788)
Pct of total intra-group comparisons significant	100.0%	0.0%	66.7%	0.0%	83.3%	83.3%	16.7%	0.0%	100.0%	50.0%	0.0%	0.0%	0.0%	0.0%	83.3%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 13. Average reported calorie intake for sugary beverage subcategories for children by household food security category

Household Food Insecurity Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Full Food Security	173.9609^{B} (4.827)	1.1823^{A} (0.3106)	14.1634^{A} (2.0505)	0.7705^{A} (0.1488)	36.1971^{B} (1.5577)	37.2315^{A} (2.2885)	9.0518^{A} (1.1411)	1.9705^{A} (0.4592)	61.4747^{B} (2.7491)	11.9192^{A} (1.3132)	2.4886^{A} (0.4046)	1.2232^{A} (0.2579)	6.7523^{A} (0.7405)	3.4435^{A} (0.5219)	40.8003^{B} (1.45)
Marginal Food Security	193.821^{AB} (9.6617)	0.7754^{A} (0.3168)	8.1364^{B} (1.3976)	0.9172^{A} (0.3766)	46.2428^{A} (3.5445)	40.4047^{A} (3.5161)	8.3632^{A} (1.0881)	0.7806^{A} (0.2795)	74.2677^{AB} (6.5115)	13.933^{A} (2.2217)	1.6348^{A} (0.3443)	1.5185^{A} (0.5589)	7.4559^{A} (1.1543)	3.7738^{A} (0.8463)	47.7723^{AB} (3.316)
Food Insecure	184.1939^{AB} (7.7149)	1.6817^{A} (0.6389)	8.7675^{AB} (1.2481)	0.466^{A} (0.2173)	46.0173^{A} (2.2818)	38.5453^{A} (3.2651)	7.7667^{A} (1.4633)	0.9552^{A} (0.2989)	68.7877^{AB} (6.9858)	11.2066^{A} (1.6318)	2.0878^{A} (0.4619)	0.8662^{A} (0.2578)	6.2029^{A} (1.2153)	3.77^{A} (0.6952)	46.0648^{AB} (2.5178)
Very Food Insecure	209.1819^{A} (9.5792)	0.8338^{A} (0.3328)	7.9002^{AB} (2.4177)	0.2989^{A} (0.1334)	47.0349^{AB} (4.0812)	43.2011^{A} (4.7824)	7.0676^{A} (1.3592)	1.7661^{A} (1.2841)	83.4405^{A} (7.4351)	17.6387^{A} (6.2114)	3.8633^{A} (1.1694)	1.4392^{A} (0.6713)	8.3503^{A} (2.3116)	2.6459^{A} (0.7467)	52.9119^{A} (3.9674)
Pct of total intra-group comparisons significant	16.7%	0.0%	16.7%	0.0%	33.3%	0.0%	0.0%	0.0%	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%	16.7%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

ANOVA TABLES FOR ADULTS (Individuals age 20+)

Table 14. Average reported calorie intake for sugary beverage subcategories for adults by age category

Age Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
20 to 39	198.9707^{A} (5.2766)	5.1595^{A} (0.9868)	15.4955^{A} (1.3095)	1.8236^{A} (0.2346)	30.1617^{A} (1.6884)	10.9414^{A} (0.9523)	1.4879^{A} (0.2324)	1.8563^{A} (0.2256)	112.1754^{A} (4.3632)	19.8694^{A} (1.6131)	28.396^{B} (1.5861)	4.0237^{B} (0.3919)	3.6511^{A} (0.4101)	3.7409^{A} (0.3492)	34.0814^{A} (1.5554)
40 to 59	132.1837^{B} (5.4152)	3.264^{A} (0.4527)	6.2488^{B} (0.698)	0.9518^{B} (0.1585)	19.3449^{B} (1.3051)	8.7612^{A} (0.9073)	1.4182^{A} (0.3341)	1.8073^{A} (0.2355)	70.325^{B} (4.3227)	20.0626^{A} (2.1259)	31.7253^{A} (1.0889)	6.0163^{A} (0.5366)	3.8049^{A} (0.4557)	3.4542^{A} (0.4389)	25.0717^{B} (1.0585)
60+	72.269^{C} (3.1184)	2.5664^{A} (0.7662)	2.816^{C} (0.7118)	0.4253^{B} (0.1677)	12.3769^{C} (0.6492)	5.8275^{B} (0.8254)	1.0026^{A} (0.2168)	2.3962^{A} (0.3924)	33.7885^{C} (1.7402)	11.0696^{B} (2.2149)	20.9086^{B} (0.9663)	4.662^{AB} (0.4779)	3.7464^{A} (0.5318)	4.4649^{A} (0.5738)	30.1855^{A} (1.3121)
Pct of total intra-group comparisons significant	100.0%	0.0%	100.0%	66.7%	100.0%	66.7%	0.0%	0.0%	100.0%	66.7%	66.7%	33.3%	0.0%	0.0%	66.7%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 15. Average reported calorie intake for sugary beverage subcategories for adults by gender

Gender Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Male	175.0564^{A} (4.5789)	3.2629^{A} (0.7177)	14.0829^{A} (0.9914)	1.1826^{A} (0.1892)	25.9481^{A} (1.3983)	10.0289^{A} (0.7171)	1.2836^{A} (0.2352)	1.8588^{A} (0.2176)	97.719^{A} (3.9399)	19.6896^{A} (1.4058)	25.5572^{A} (1.2049)	4.467^{A} (0.3582)	4.1271^{A} (0.4131)	3.6843^{A} (0.3337)	33.764^{A} (1.1659)
Female	111.2033^{B} (3.5283)	4.2578^{A} (0.5217)	3.9654^{B} (0.4128)	1.0997^{A} (0.1914)	17.5751^{B} (0.8508)	7.7245^{B} (0.7588)	1.3889^{A} (0.2429)	2.0789^{A} (0.2066)	57.1838^{B} (2.4819)	15.9292^{B} (1.3878)	26.2683^{A} (0.9371)	5.3725^{A} (0.4348)	3.3764^{A} (0.3443)	3.9337^{A} (0.3446)	25.9644^{B} (0.8901)
Pct of total intra-group comparisons significant	100.0%	0.0%	100.0%	0.0%	100.0%	100.0%	0.0%	0.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 16. Average reported calorie intake for sugary beverage subcategories for adults by poverty income ratio category

Poverty Income Ratio Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
<130%	199.733^{A} (6.9362)	4.3455^{A} (0.975)	11.3372^{A} (1.6469)	0.6851^{A} (0.1484)	28.9638^{A} (1.9365)	11.278^{A} (1.016)	1.7661^{A} (0.4328)	1.1177^{B} (0.1886)	118.0241^{A} (5.5128)	22.2155^{A} (2.2802)	29.1828^{A} (1.6812)	5.515^{A} (0.7082)	5.0612^{A} (0.6418)	3.6682^{A} (0.4132)	34.8337^{A} (1.8993)
130% - 185%	164.0486^{B} (9.5775)	2.2309^{A} (0.6853)	8.0234^{A} (1.0703)	1.214^{A} (0.3596)	25.4111^{AB} (1.8308)	11.9218^{AB} (1.9111)	1.0753^{A} (0.3636)	1.2285^{B} (0.2915)	86.5178^{B} (5.971)	26.426^{AB} (5.5823)	25.0466^{A} (1.9196)	4.3966^{A} (0.7819)	3.4269^{AB} (0.5642)	3.5671^{A} (0.513)	31.2521^{AB} (2.9469)
186% - 250%	149.3622^{BC} (8.5228)	3.3091^{A} (0.774)	7.764^{A} (1.4367)	1.1927^{A} (0.4447)	21.1694^{ABC} (2.481)	10.5265^{AB} (1.7567)	0.8016^{A} (0.2757)	1.4122^{AB} (0.3125)	83.3924^{B} (7.0239)	19.7945^{AB} (3.3797)	23.9369^{A} (1.8998)	4.4809^{A} (0.7537)	3.8485^{AB} (0.8687)	4.0284^{A} (0.7425)	28.1602^{AB} (2.1101)
251% - 350%	134.1934^{C} (5.2407)	5.2788^{A} (1.0967)	11.1638^{A} (2.3102)	1.5606^{A} (0.6517)	19.8573^{BC} (2.0096)	6.4941^{B} (0.8813)	1.17^{A} (0.4681)	2.5388^{AB} (0.6728)	68.4914^{BC} (4.2377)	17.6386^{AB} (2.4632)	25.9173^{A} (1.6858)	4.4988^{A} (0.4624)	4.1265^{AB} (0.9309)	4.0479^{A} (0.7581)	25.8947^{B} (1.8238)
>350%	107.3055^{D} (4.664)	3.811^{A} (0.7127)	6.9496^{A} (0.4951)	1.2683^{A} (0.2082)	16.9486^{C} (1.391)	7.1183^{AB} (0.9243)	1.3621^{A} (0.3148)	2.6476^{A} (0.2941)	53.619^{C} (3.7417)	13.581^{B} (1.5211)	24.7831^{A} (1.0808)	5.1029^{A} (0.5381)	2.5018^{B} (0.3567)	3.8002^{A} (0.4717)	27.239^{B} (1.2929)
Pct of total intra-group comparisons significant	80.0%	0.0%	0.0%	0.0%	30.0%	10.0%	0.0%	20.0%	60.0%	10.0%	0.0%	0.0%	10.0%	0.0%	20.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 17. Average reported calorie intake for sugary beverage subcategories for adults by educational attainment

Educational Attainment of Household Reference Person Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Less than high school	177.5531^{A} (5.7825)	2.0899^{A} (0.5877)	9.6218^{A} (1.0963)	0.6861^{A} (0.189)	26.207^{A} (2.088)	10.9627^{A} (1.3714)	0.7308^{A} (0.2523)	1.1244^{B} (0.2139)	109.9558^{A} (5.3318)	16.1746^{B} (1.7755)	29.4643^{A} (1.402)	5.0426^{A} (0.8421)	5.622^{A} (0.8277)	3.2101^{A} (0.463)	30.6397^{A} (1.9829)
High school graduate/GED	170.1277^{A} (5.1039)	2.6931^{A} (0.5452)	9.6857^{A} (1.0792)	1.1695^{A} (0.2892)	23.8717^{AB} (1.7256)	8.7264^{A} (1.0093)	1.518^{A} (0.392)	1.1962^{B} (0.3552)	98.5886^{A} (4.8956)	22.6785^{A} (2.254)	26.4045^{AB} (1.815)	4.9582^{A} (0.5964)	4.18^{AB} (0.8764)	3.2362^{A} (0.4145)	27.7317^{A} (1.6369)
Some college or more	121.5275^{B} (3.7623)	4.5818^{A} (0.6973)	8.2837^{A} (0.7552)	1.1973^{A} (0.158)	19.6135^{B} (1.2323)	8.3267^{A} (0.7835)	1.503^{A} (0.2416)	2.4825^{A} (0.2267)	59.3037^{B} (2.4771)	16.2354^{B} (1.3828)	24.6766^{B} (0.9837)	4.9408^{A} (0.3959)	3.0785^{B} (0.3104)	4.1702^{A} (0.3526)	30.3154^{A} (0.8885)
Pct of total intra-group comparisons significant	66.7%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	66.7%	66.7%	66.7%	33.3%	0.0%	33.3%	0.0%	0.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 18. Average reported calorie intake for sugary beverage subcategories for adults by cohabitation status

Cohabitation Status of Household Reference Person Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Married or living with partner	133.6897^{B} (3.6775)	4.0705^{A} (0.6445)	8.2916^{AB} (0.6151)	1.1723^{A} (0.1486)	20.1461^{B} (1.0556)	8.2672^{A} (0.6793)	1.4482^{A} (0.2023)	1.8149^{A} (0.1944)	72.0446^{B} (2.9347)	16.4344^{A} (1.378)	25.9483^{AB} (0.8481)	4.756^{A} (0.3201)	3.8228^{A} (0.343)	3.9048^{A} (0.255)	28.4353^{B} (0.847)
Widowed, Divorced, Separated	144.2147^{B} (8.5456)	2.4633^{A} (0.5027)	7.1291^{B} (1.2705)	0.8675^{A} (0.1781)	19.5345^{B} (1.5122)	10.6585^{A} (1.3626)	0.9871^{A} (0.3205)	2.3471^{A} (0.4524)	76.9478^{B} (5.7761)	23.2797^{A} (4.2739)	29.6343^{A} (1.8984)	5.4637^{A} (0.6989)	3.9272^{A} (0.593)	3.7976^{A} (0.7236)	28.7428^{B} (1.5974)
Never Married	173.0691^{A} (6.3097)	3.7439^{A} (0.6917)	13.1001^{A} (2.0877)	1.3348^{A} (0.3458)	29.6971^{A} (2.3884)	8.5565^{A} (1.13)	1.3752^{A} (0.3658)	2.2895^{A} (0.4665)	96.6475^{A} (5.0263)	16.3245^{A} (1.4702)	20.8982^{B} (2.2013)	4.9872^{A} (0.9178)	3.2069^{A} (0.682)	3.2175^{A} (0.4533)	36.6131^{A} (2.7231)
Pct of total intra-group comparisons significant	66.7%	0.0%	33.3%	0.0%	66.7%	0.0%	0.0%	0.0%	66.7%	0.0%	33.3%	0.0%	0.0%	0.0%	66.7%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 19. Average reported calorie intake for sugary beverage subcategories for adults by race/ethnicity category

Race Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Mexican American	181.4291^{A} (5.0488)	3.668^{A} (1.0074)	10.8013^{A} (1.2433)	0.8772^{A} (0.2367)	32.3908^{B} (2.6449)	12.0583^{A} (1.4361)	0.8972^{AB} (0.4298)	1.3879^{B} (0.379)	107.2274^{A} (4.2935)	12.121^{B} (2.0329)	28.2732^{A} (1.5521)	3.8047^{B} (0.7259)	8.6753^{A} (1.1909)	5.2838^{A} (0.937)	33.385^{B} (1.4821)
Other Hispanic and Other Race	129.3203^{B} (5.8234)	4.4448^{A} (0.9209)	7.4369^{A} (1.1489)	1.0535^{A} (0.2083)	25.4719^{B} (1.8814)	8.1528^{AB} (1.0037)	0.7406^{B} (0.2154)	4.229^{A} (0.6887)	64.2181^{C} (3.6316)	13.5729^{B} (2.5557)	28.2907^{A} (1.8003)	5.2266^{AB} (0.5046)	9.1374^{A} (1.199)	4.1185^{A} (0.5985)	32.929^{B} (2.1004)
Non-Hispanic White	132.478^{B} (4.8384)	3.97^{A} (0.6143)	8.9334^{A} (0.6705)	1.1368^{A} (0.155)	15.352^{C} (1.0425)	8.7607^{AB} (0.6417)	1.6451^{A} (0.2204)	1.6862^{B} (0.1963)	72.5546^{C} (4.0788)	18.4391^{AB} (1.6724)	25.9212^{A} (1.0471)	4.7545^{AB} (0.3997)	2.396^{B} (0.3343)	3.4155^{A} (0.3413)	26.0176^{C} (0.9154)
Non-Hispanic Black	178.9834^{A} (4.1531)	2.0579^{A} (0.5292)	7.7746^{A} (1.3956)	1.4427^{A} (0.3552)	46.2214^{A} (1.9834)	7.4532^{B} (0.8653)	0.4852^{B} (0.1411)	1.7205^{B} (0.3595)	89.7463^{B} (3.1715)	22.0817^{A} (1.3706)	21.687^{B} (1.1617)	6.6102^{A} (0.7658)	2.1987^{B} (0.3828)	4.7654^{A} (0.4685)	45.2133^{A} (1.6767)
Pct of total intra-group comparisons significant	66.7%	0.0%	0.0%	0.0%	83.3%	16.7%	33.3%	50.0%	83.3%	33.3%	50.0%	16.7%	66.7%	0.0%	83.3%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 20. Average reported calorie intake for sugary beverage subcategories for adults by BMI category

BMI Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Underweight (BMI <18.5)	133.9323^{AB} (12.8503)	1.1577^{B} (0.5668)	12.2047^{A} (2.2006)	0.333^{B} (0.215)	14.885^{B} (2.3588)	7.5598^{A} (2.0818)	1.3878^{A} (0.7364)	2.9758^{AB} (1.9516)	82.8608^{AB} (10.9515)	10.5678^{B} (2.7215)	25.8962^{A} (4.5721)	5.761^{A} (1.2379)	4.2693^{A} (2.2762)	1.8957^{B} (0.7172)	37.6579^{AB} (6.1317)
Normal (BMI 18.5-24.9)	138.8487^{AB} (6.0057)	3.3767^{A} (0.6386)	9.0531^{A} (1.0271)	1.6821^{A} (0.2899)	20.8369^{AB} (1.5034)	6.81^{A} (0.8051)	1.8616^{A} (0.3898)	2.6439^{A} (0.2906)	76.0808^{AB} (4.1984)	16.5036^{AB} (2.2973)	26.4217^{A} (1.3142)	5.5011^{A} (0.5576)	3.6661^{A} (0.5125)	4.7903^{A} (0.6505)	32.6767^{A} (1.7511)
Overweight (BMI 25-29.9)	135.4386^{B} (4.2468)	4.715^{A} (1.1877)	9.9119^{A} (0.9469)	0.7751^{AB} (0.1768)	20.8318^{AB} (1.3151)	9.6784^{A} (1.0813)	1.2469^{A} (0.2513)	1.993^{AB} (0.2901)	70.0375^{B} (3.7028)	16.2491^{AB} (1.5631)	25.9195^{A} (1.2203)	4.7464^{A} (0.5108)	3.9447^{A} (0.4636)	3.9571^{AB} (0.4491)	29.6416^{AB} (1.0191)
Obese (BMI >= 30)	149.9926^{A} (4.3868)	3.4247^{A} (0.5071)	7.2758^{A} (0.6992)	1.1023^{A} (0.1891)	23.2674^{A} (1.3117)	9.7061^{A} (0.8815)	1.0063^{A} (0.2362)	1.3568^{B} (0.232)	82.3149^{A} (3.4697)	20.5384^{A} (1.7917)	25.5521^{A} (1.277)	4.6229^{A} (0.4232)	3.5543^{A} (0.4753)	3.0424^{AB} (0.328)	26.7784^{B} (1.0533)
Pct of total intra-group comparisons significant	16.7%	50.0%	0.0%	33.3%	16.7%	0.0%	0.0%	16.7%	16.7%	16.7%	0.0%	0.0%	0.0%	16.7%	16.7%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 21. Average reported calorie intake for sugary beverage subcategories for adults by reported calorie intake category

Average Reported Calorie Intake Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
<= 1400	64.7697^{D} (2.5097)	2.6816^{A} (0.6411)	3.6481^{C} (0.5152)	0.7372^{A} (0.1449)	10.6254^{D} (0.7927)	3.6505^{C} (0.5234)	0.8916^{A} (0.2185)	1.4792^{B} (0.2257)	33.7806^{D} (2.2902)	7.2756^{D} (0.7155)	18.9712^{C} (0.8743)	3.1791^{C} (0.3481)	2.587^{B} (0.4239)	2.3153^{C} (0.3481)	18.274^{D} (0.9106)
<= 1800	97.5793^{C} (3.9341)	4.1776^{A} (0.9281)	4.2847^{C} (0.5416)	1.2349^{A} (0.3351)	15.0059^{C} (1.0025)	6.2831^{BC} (1.0497)	0.7417^{A} (0.2225)	1.922^{AB} (0.2778)	51.247^{C} (2.8043)	12.6825^{C} (1.1836)	22.8262^{B} (1.196)	4.086^{BC} (0.377)	3.2608^{B} (0.4097)	3.051^{BC} (0.3371)	24.8159^{C} (1.365)
<= 2400	132.0469^{B} (3.7073)	3.704^{A} (0.6303)	7.5436^{B} (0.9163)	0.9938^{A} (0.1885)	20.8673^{B} (1.3428)	7.5107^{B} (0.8583)	1.4163^{A} (0.2722)	1.7322^{AB} (0.2697)	71.0277^{B} (3.3937)	17.2515^{B} (1.456)	24.8521^{B} (1.0649)	5.2157^{AB} (0.4711)	3.2276^{B} (0.385)	4.1048^{AB} (0.4154)	30.3665^{B} (1.3598)
> 2400	233.4725^{A} (7.5757)	4.2756^{A} (0.7698)	16.711^{A} (1.5847)	1.4752^{A} (0.3296)	34.1584^{A} (1.9409)	15.3868^{A} (1.3598)	1.9901^{A} (0.4266)	2.5816^{A} (0.3853)	128.2623^{A} (6.2175)	28.6315^{A} (2.9448)	33.8151^{A} (1.9527)	6.4184^{A} (0.7723)	5.3476^{A} (0.6545)	5.0395^{A} (0.6617)	39.8553^{A} (1.9207)
Pct of total intra-group comparisons significant	100.0%	0.0%	83.3%	0.0%	100.0%	66.7%	0.0%	16.7%	100.0%	100.0%	83.3%	50.0%	50.0%	50.0%	100.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Table 22. Average reported calorie intake for sugary beverage subcategories for adults by household food security category

Household Food Insecurity Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
Full Food Security	124.0212^{C} (3.5321)	3.8191^{A} (0.5585)	7.4368^{B} (0.5238)	1.2091^{A} (0.1362)	19.2167^{B} (0.9788)	8.2259^{A} (0.6039)	1.445^{A} (0.2074)	2.1258^{A} (0.1954)	64.4467^{C} (3.0021)	16.0962^{A} (1.2392)	25.0472^{B} (0.9294)	5.1588^{A} (0.377)	3.1474^{B} (0.2941)	3.8919^{A} (0.2887)	28.9497^{AB} (0.8968)
Marginal Food Security	182.14^{B} (8.4472)	4.434^{A} (1.0917)	12.2301^{AB} (2.5881)	0.9336^{AB} (0.3365)	28.6977^{A} (2.5754)	11.0849^{A} (2.2891)	0.7233^{A} (0.3089)	1.8529^{AB} (0.4828)	104.3106^{B} (6.697)	17.873^{A} (1.6133)	26.111^{B} (2.0421)	4.103^{A} (0.7594)	6.4571^{A} (1.1502)	3.5609^{A} (0.519)	29.9832^{AB} (2.131)
Food Insecure	202.8952^{AB} (8.8592)	3.2857^{A} (0.7832)	13.7376^{A} (1.7824)	0.5663^{B} (0.1463)	30.5051^{A} (2.465)	9.7116^{A} (1.2818)	1.5543^{A} (0.6088)	1.0943^{B} (0.2666)	119.5214^{AB} (6.8417)	22.9188^{A} (2.744)	29.1407^{AB} (2.2502)	4.3229^{A} (0.644)	5.2705^{AB} (1.0357)	3.626^{A} (0.7794)	36.404^{A} (3.0942)
Very Food Insecure	231.9751^{A} (13.326)	2.802^{A} (1.6092)	14.3136^{AB} (3.7281)	1.3573^{AB} (0.4171)	29.8199^{A} (3.2378)	12.2472^{A} (1.9966)	0.5053^{A} (0.2646)	1.3438^{AB} (0.5952)	135.881^{A} (8.8816)	33.7049^{A} (9.9701)	34.2905^{A} (2.7034)	4.3678^{A} (0.8067)	5.9704^{AB} (1.3916)	3.4535^{A} (1.0019)	26.6647^{B} (2.1293)
Pct of total intra-group comparisons significant	66.7%	0.0%	16.7%	16.7%	50.0%	0.0%	0.0%	16.7%	66.7%	0.0%	33.3%	0.0%	16.7%	0.0%	16.7%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

Age

Tables 4 and 12 provide mean caloric estimates by age categories for children and adults respectively. Among children, adolescents reported consuming significantly[2] more calories from other age groups from all SSBs, Coffee Beverages, Energy Drinks, Flavored Water, Soda, Sweetened Tea, Coffee Combinations and Tea Combinations. Toddlers had the highest caloric consumption per capita from milk combinations, juice combinations and juice. Young children reporting consuming significantly more calories from Fruit Drinks, and Low-Fat Flavored Milks. Regular Flavored Milks were consumed significantly more by toddlers and young children in comparison with adolescents. There were no differences in reported calories consumed in terms of Sweetened Non-Dairy Beverages.

Among adults, young adults reported consuming significantly more calories from total SSBs, Energy Drinks, Flavored Water, Fruit Drinks, and Soda. Middle-aged adults reported consuming the most calories from Coffee Combinations and Tea Combinations. Young and middle-aged adults consumed significantly more calories from Flavored Milk and Sweetened Tea than seniors. There were no differences in consumption between the three adult age groups in terms of Coffee Drinks, Flavored Low-Fat Milk, Sweetened Non-Dairy Beverages, Milk Combinations or Juice Combinations.

[2] In this section, the basis for all denotations of "significant" is a Tukey-Kramer adjusted p value of less than 0.05. Unless otherwise noted, if a single group is said to be significantly higher/lower, then it means that it is significantly different on the basis of comparisons with each other subgroup separately.

In sum, age is a useful variable in predicting differences in mean consumption for many sugary drink sub categories, but not all. More intra-group differences exist between child age-groupings but this is unsurprising given the heterogeneity of the metabolisms of children in the different age groupings.

Gender

The results included in this analysis are consistent with what has already been well documented in the literature of the tendency of men to report larger caloric intakes of sugary beverages across the board. Male children report consuming significantly more calories from SSBs overall, Energy Drinks, Flavored Milks, Soda, and Juice. However, female children report consuming more calories from Coffee Drinks. No differences in mean consumption were observed for any of the remaining categories. Among adults, men reported consuming more calories from SSBs overall, Energy Drinks, Fruit Drinks, Flavored Milks, Soda, Sweetened Tea, and Juice.

Given the significantly larger consumption of Coffee Drinks and Coffee Combinations by adolescents, it seems likely that the significantly larger caloric intake of Coffee Drinks among Females is also coming from adolescents. Though small (less than 2 calories per day on average for females) this speaks to what may be an increasing prevalence for Coffee Drinks among this subpopulation. If adolescent men have been consuming more drinks with energetic stimulants (Kit et al., 2013), Coffee Drinks may be the counterpart for young women. In adulthood, however, it seems that there are no

significant differences between Coffee Drinks and Coffee Combinations between men and women.

Ratio of Family Income to Poverty

Significant differences in the reported caloric consumption of beverages by family income to poverty ratio category exist for children only for Fruit Drinks, Coffee Combinations, and Juice Beverages – and in these cases only between the lowest (<130% of PIR) and the second highest (251%-351%) or highest (>350%) levels. No significant differences were observed in consumption for any other sugary beverage category (with the exception of a single difference between the lowest income group and the middle income group in consumption of Coffee Drinks).

The family income to poverty ratio served as a better intra-group differentiator for adults. Of the 10 intra-group comparisons conducted for each PIR level, 8 were significant for the total SSBs category, 3 were significant for the Fruit Drink category, and 6 were significant for the Soda category. Each of these categories showed a significant difference between the lowest income group and the highest group, with groups in the middle showing fewer mean calories as family income rose. Similar patterns – although with fewer intra-group statistically significant differences – were observed with Sweetened Tea and Juice. No significant differences were observed between groups for Coffee Drinks, Energy Drinks, Flavored Water, Flavored Low-Fat Milk, Coffee Combinations, Tea Combinations and Juice Combinations.

It seems that overall, income – as measured by the family's income to poverty ratio – is a better predictor of differences in reported calorie consumption for adults than for children – if only for SSBs overall and two of the major SSB subtypes: Soda and Fruit Drinks. It is interesting to note that although the NHANES frequently conducted interviews with parents and children of the same families (on average, the NHANES sampled 1.6 family members from selected households) (CDC, 2011) the same general tendency for calories from SSBs overall, Soda and Fruit Drinks to decrease as income increased was not observed. This may suggest that children's beverage consumption patterns is being mediated by other factors than what their parents are consuming – such as the availability of certain beverages in school or other non-home locations.

Education

Children with parents who have less than a high school education drink significantly more soda than children whose parents graduated from high school, attended college or more. Children who have parents with higher levels of education (some college or more) drink significantly more calories than children with less educated parents. Significant differences were observed between children of college educated parents and children of high school graduates in terms of the average number of calories from fruit drinks, but neither of these were significantly different from the average number of calories observed for children of parents with less than a high school education. No significant differences were observed by parents' level of education were observed for SSBs overall, or any other sugary beverage subcategory.

Adults who attended college reported consuming significantly fewer calories from SSBs overall and sodas than those who were high school graduates or did not graduate from high school. Adults with some college reported consuming fewer calories from Fruit Drinks, Coffee Combinations, and Milk Combinations than adults who did not finish high school. College educated adults also reported consuming significantly more calories from Sweetened Non-Dairy Beverages than any other adults. No significant differences were observed for Coffee Beverages, Energy Drinks, Flavored Water, Flavored Milk, Flavored Low-Fat Milk, Tea Combinations, Juice Combinations or Juice.

The level of education of the household reference person seems to be a better indicator of beverage consumption patterns for adults than for children. Of the 45 intra-group comparisons made (3 for each beverage category and 15 beverage categories) only 5 were significant for children but 10 were significant for adults. For adults, these included significant differences in reported consumption of calories from SSBs overall, and two of the most significant SSB subcategories: Soda and Fruit Drinks. As with the family income to poverty ratio, this suggests that a parents' characteristics and consumption patterns do not necessarily dictate their children's or that children's consumption patterns are mediated by more factors outside of the home.

Cohabitation Status of Household Reference Person

Children with parents who were widowed, divorced, or separated (referred to as "separated" from here forward) consumed more total calories from SSBs overall, Soda, and Sweetened Tea than children who had parents who were married or living with

partners. Children with parents who were married or lived with a partner reported consuming fewer calories from Fruit Drinks than children with parents who were separated. Children with parents who were never married reported consuming the largest number of calories from Fruit Drinks and Juice. No significant differences were observed for any Combination-type beverage, Coffee Drinks, Energy Drinks, Flavored Water, or Flavored Milks.

Adults who were never married reported consuming significantly more calories from SSBs overall, Soda, Fruit Drinks, and Juice than adults who were married or living with partners or adults who were widowed, divorced, or separated. Individuals who were never married reported consuming significantly fewer calories from Coffee Combinations than any other group although this difference was not significantly less than adults who were married or living with a partner. No other significant differences were observed for Coffee Drinks, Flavored Water, Flavored Milk, Flavored Low Fat Milk, Sweetened Non-Dairy Beverages, Sweetened Tea, Tea Combinations, Milk Combinations, or Juice Combinations.

It has been suggested that the stress of caregiving plays an important role in determining dietary decisions both for adults and the children they care for. This is particularly true for single mothers, for whom the coincidence of obesity and poverty are markedly more prevalent (Henriksen et al., 2014; Martin & Lippert, 2012). The hypothesis that that parents who are more socially isolated (those who never married) are more stressed than those who are married or living with partners and that this stress inclines “comfort-food”-seeking behavior, is supported for Fruit Drinks and Juices for

children and All SSBs, Fruit Drinks, Soda, and Juice for adults. To be sure, these are some of the more significant categories in terms of their mean caloric contributions to dietary intake, but more research would be necessary to tease out the mediating effects of other variables in determining this relationship, especially give that most of the inter-group comparisons for most other sugar-beverage subcategories are not significant.

Race

Other Hispanic / Other Race – Including Multi Racial (hereafter "Other Race") children reported consuming the smallest number of calories from SSBs overall – significantly fewer than Non-Hispanic White (hereafter "White") or Non-Hispanic Black (hereafter "Black") children. White children reported consuming the most calories from Energy Drinks – significantly more than Mexican-American and Other Race children. Fruit Drinks were consumed in the largest caloric quantity by black children (72.2 calories per day) and in the smallest quantity by white children (29.9 calories per day), who both differed significantly from Mexican American and Other Race children whose consumption was between the two (40.5 and 41.2 calories, respectively). Consumption of Sweetened Non-Dairy Beverages was highest for Other Race children and was significantly higher than Mexican American and Black children. Consumption of soda was highest for White children (74.6 calories) and significantly higher than Black children (53.0 calories) or Other Race children (44.0 calories). Similarly, consumption of Sweetened Tea was highest for White children (14.8 calories) and was significantly

higher than Mexican-American or Other Race children. Mexican American and Other Race children consumed significantly more calories from Milk Combinations (11.3, 12.3) than White or Black children (5.5, 4.0). White children reported consuming significantly fewer calories from juice (36.0) than another other race/ethnicity group.

Mexican American and Black adults consumed more total calories from SSBs (181.9, 179.0) than White or Other Race groups (132.2, 129.6). Blacks reported consuming significantly more calories from Fruit Drinks (46.2 calories) than any other group, and Whites reported consuming significantly fewer than any other group (15.3 calories). Other Race adults reported consuming significantly more calories from Sweetened Non-Dairy Beverages (4.7 calories) than any other group. Mexican American adults reported consuming significantly more calories from soda than any other group (107.2 calories), and Blacks also differed significantly in their consumption of soda (89.8 calories) in comparison to either White adults (72.5 calories)or Other Race adults (64.2 calories). Blacks consumed significantly more calories from Sweetened Tea (22.0 calories) in comparison to Mexican American or Other Race adults. Blacks also consumed significantly fewer calories from Coffee Combinations (22.6 calories) than any other group.

In comparison with several other categories thus far analyzed, the analyses in this section show that the race/ethnicity is a useful variable in describing differences in consumption by beverage type. Consistent with the literature, Black adults and children are consuming more calories from Fruit Drinks, and Black adults are consuming fewer calories from Milks. Other Race children and adults are consuming the largest number of

calories from Sweetened Non-Dairy Beverages and this is unsurprising given the lactose intolerance of many people of Asian descent. For adults, consumption of Soda roughly tracks the consumption of SSBs overall. Of course, in large part, this is because Soda is consistently the largest contributor to total SSB calories, but it is useful to know that consumption of this specific beverage type may correlate with overall SSB consumption.

BMI

The BMI category was only analyzed for adults because the heterogeneity of body types for the children's age group does not merit their comparison. Significant differences were observed between Overweight and Obese adults in terms of reported consumption of SSBs overall (135.0, and 149.8 calories), and Soda (82.3, and 70.0 calories). In three cases, underweight individuals reported consuming significantly fewer calories than at least one other group: Coffee Drinks (1.2 calories), Fruit Drinks (14.9 calories), and Sweetened Tea (10.43 calories).

The hypothesis that higher BMIs would show higher caloric consumption levels from any given sugary beverage category is not well supported by these results. Few other meaningful differences existed between BMI groups along these lines and no significant differences were observed for Energy Drinks, Flavored Milks, Sweetened Non-Dairy Beverages, Coffee Combinations, Tea Combinations, and Milk Combinations.

Average Reported Calorie Intake Category

Unsurprisingly, the reported calorie intake category is useful in differentiating reported caloric consumption from sugary beverage subcategories for both children and adults. Significant differences exist between each subgrouping and every other subgrouping for both adults and children in terms of reported calories from SSBs overall and from Soda. Among children, individuals who reported consuming between 1,800 and 2,400 calories and greater than 2,400 calories reported consuming significantly more calories from Energy Drinks, Fruit Drinks, Flavored Milk, than groups who consumed fewer than 1,400 calories or between 1,400 and 1,800 calories. Children who consumed more than 2,400 calories reported consuming significantly more Sweetened Tea than any other group. For adults, reported caloric consumption of Fruit Drinks, Sweetened Tea, and Juice was significantly different for each subgroup in comparison to the other subgroups. Adults who reported consuming more than 2,400 calories also consumed significantly more calories from Energy Drinks, Flavored Milks, Coffee Combinations, and Milk Combinations than any other group. Individuals who reported consuming fewer than 1,400 calories also consumed significantly fewer calories from Coffee Combinations than any other group.

Food Security

Children in fully food secure households reported consuming fewer total calories from SSBs than very low food security children. Fully food secure children also consumed more calories from Energy Drinks, but this difference was only significant in

comparison with the marginal food security group. Fully food secure children consume fewer calories from Fruit Drinks in comparison to children who are marginally food secure and those who are very food insecure. The only beverage categories for which a significant difference existed between the fully food secure group and the very food insecure group was for Soda, and Juice. In these cases, marginally food secure and food insecure children were not different from one another or from the fully food secure or very food insecure groups.

For adults, a trend may be observed between the level of food security and the number of total reported calories from SSBs and Soda. In general, as food security increases, the number of reported calories from total SSBs and Soda decreases. Differences are significant between the fully food secure, the marginally secure and the very food insecure (the fully food secure is also significantly different from the food insecure, but the food insecure group is not statistically distinct from the marginally secure or the very food insecure group). Similar patterns appear – albeit with fewer statistically significant differences with Energy Drinks and Coffee Combinations. Fully food secure groups get fewer calories from Fruit Drinks than all other groups and the most calories from Sweetened Non-Dairy Beverages, although this is only statistically significant in comparison with the food insecure group.

Among children, food security seems to be an appropriate differentiator of sugary beverage subcategory intake between those groups at the margins of low and high food security, and only for Fruit Drinks, Sodas, and Juices. Among adults, this pattern is slightly more marked, particularly for all SSBs and Sodas.

4.4. Discussion

These analyses provide an important glimpse at the role of a number of variables that are commonly hypothesized in the research to contribute to differences in caloric consumption of beverages. For children, the lack of a large number of significant differences was noteworthy for two variables in particular: family income to poverty ratio and education of household reference person. Hypotheses that these common socio-economic indicators contributed to the number of reported calories consumed was not borne out. Further research should consider the ways in which children's beverage consumption patterns outside of the home differs from their parents and how these are mediated by other factors such as beverages available in a school environment.

For adults, family income to poverty ratio, education, and food security status did seem to be a meaningful indicator of significant differences in total SSB consumption, and – to a lesser extent – differences in Soda and Fruit Drinks consumption. Where there were significant differences in consumption between groups this occurred more frequently at the margins between high and low groups.

Public health campaigns have focused extensively on Soda as the key contributor to excessive caloric intake. The media's coverage of these issues may often help paint a picture of Soda as "public enemy number 1" in terms of American consumers' diets. Taken as a whole, this analysis suggests tentatively that this emphasis on Sodas is justified because of its enormous average caloric contribution to dietary intake. Unsurprisingly, reported caloric intake from Sodas tracked well with reported

caloric intake from SSBs overall, particularly for adults. This observation was true, albeit to a lesser extent, with Fruit Drinks.

BMI was not a particularly useful differentiator in reported caloric intake among adults. This suggests that the connection between body type, health, or diet quality and caloric intake from sugary beverages is more complex than this relatively simple analysis can consider, or – as has been mentioned – it may point to the insufficiency of BMI as a measure of dietary quality or health.

CHAPTER 5: SOCIODEMOGRAPHIC TRENDS IN SSB CONSUMPTION

5.1 Consumption Trends

5.1.1 Consumption Trends for SSBs Overall

Although overall SSB consumption increased consistently before the mid 2000's (Bleich et al., 2009; Murphy & Douglass, 2007; Nielsen & Popkin, 2004), several more recent studies have found that total SSB consumption has been in relative decline (Bleich et al., 2018; Han & Powell, 2013; Kit et al., 2013; Piernas et al., 2013). As Bleich et al (2018) report, this has primarily been due to the fact that fewer people are electing to consume SSBs and consuming less per capita.

In general, across age groups and race/ethnicity categories, men report drinking more SSBs than women. This is unsurprising given the caloric requirements of men on average are larger than women. Peak SSB consumption is consistently observed in teenagers (ages 12 to 19) or young adulthood (ages 20 to 39), with the lowest consumption levels among seniors (aged 60 and older) (Kit et al., 2013; Storey et al., 2006).

Race and ethnicity are also important factors to consider in terms of overall consumption of SSBs, although consumption can change significantly when taking other factors into account. Overall and on average, non-Hispanic white individuals consume more total SSBs by calorie per day than any other race/ethnicity group (Han & Powell, 2013). However, logistic regression analysis conducted by Han & Powell found that

being black increased the likelihood of consuming more SSBs than white individuals across age groups whereas being Hispanic increased the likelihood for adults only. Any other race/ethnicity (considered as a group) was no more likely than whites to consumer more SSBs overall.

Other socioeconomic factors have been analyzed in the literature in terms of their role in overall SSB consumption. For example, having low income has been associated with the likelihood of greater overall consumption of SSBs only for adults over age 20 (Han & Powell, 2013). An analysis by Ogden and colleagues (2011a) found that low income individuals generally get more of their total share of calories from sugary beverages than high income adults and that this difference is greater for adults. Having a higher income has been associated with a lower prevalence for purchasing calorically sweetened beverages and a higher prevalence for purchasing low-calorie sweeteners (Piernas et al., 2013).

Having a low level of education has been consistently positively associated with frequent SSB consumption and with greater overall consumption of SSBs relative to individuals with more education (Bleich et al., 2009; Han & Powell, 2013).

5.1.2 Consumption by Major SSB Subtypes

Soda

In large part, the public debate about sugary beverages has focused primarily on sodas. This is for good reason, given that regular non-diet soda is by far the largest single contributor to added sugars and calories for all age, gender, and socioeconomic categories

across the board. However, this public focus on soda often eclipses the large role that is also played by other types of SSBs. As documented in the previous section, other analyses typically include fruit drinks and sports/energy drinks as the major other SSB beverage types. The unique contribution of this article is to document and analyze the contributions of several additional beverage types to give a full picture of the beverage landscape.

In general, soda consumption by total calories and by prevalence (instances of consumption) has decreased among all children younger than 19 in recent years (Bleich et al., 2018; Han & Powell, 2013; Kit et al., 2013). Per capita, adults ages 20 to 59 have also been consuming less calories from soda, but adults 60 and older have continued soda at similar rates since the mid 2000s (Bleich et al., 2018). Given that approximately one half of the NHANES sample in each age group from 1999 to 2008 consumed soda, Han & Powell note that the public focus on soda is still well merited (2013).

In general, recent studies have documented that consumption of soda tracks the general pattern in consumption of SSBs overall: that is, consumption increases through teenage years and into young adulthood and then begins to decrease in late adulthood . Teenagers have the highest prevalence and highest caloric intake of soda than any other age group with consumption by teenage males consistently leading consumption rates by other age/gender groups (Bleich et al., 2018; Murphy & Douglass, 2007).

Han and Powell found that the odds of heavy consumption of soda (consumption in excess of 500 calories/day) were lower among blacks and Mexican-Americans than for whites. These researchers also found that the odds of heavy consumption of soda was

higher among individuals with a low-level of education than those with a higher level of education. Compared with whites, blacks consumed less regular soda on average per day. As with SSB consumption in general, being black, low income or having a low level of educated has been associated with frequent soda consumption (Han & Powell, 2013).

Fruit Drinks

Behind soda, recent analyses have shown that fruit drinks are the second most frequently consumed beverage type and contribute the second most calories to individual diets. Like soda, consumption of fruit drinks has been decreasing in recent years (Bleich et al., 2018).

Han & Powell (2013)found that fruit drinks — not soda — were the largest energy source among SSBs for children ages 2-11 years old.

On average and per day, African Americans consume more fruit drinks than any other race/ethnicity group. Hispanics were also at increased odds of consuming fruit drinks relative to whites for all age groups except children (Han & Powell, 2013) .

Low income children are more likely than their high-income counterparts to be heavy consumers of fruit drinks (Han & Powell, 2013).

Energy and Sport Drinks

With regard to changes in consumption of sports and energy drinks in recent years finding have been mixed. This seems to be due, in large part, to the use of different NHANES samples in different studies and to differences in the categorization of sports

drinks or energy drinks as “other” types of SSBs. Using NHANES data from 1999-2008 Han and Powell found that consumption in calories of sports and energy drinks has decreased in recent years (Han & Powell, 2013). Kit and colleagues — who used a similar NHANES study period (1999-2010) — found that consumption of sports and energy drinks had increased. Although Han and Powell found that the prevalence of consumption of sports drinks among adolescents (age 12 to 19) tripled over the period of their study, using the most recent NHANES data, Bleich and colleagues found that this increase had not been sustained among adolescents and that neither children nor adults experienced significant changes in caloric consumption of sports drinks over the period of their study.

Being black and low income was each associated with greater likelihood of consumption of sports/energy drinks among children and adolescents, but not among adults (Han & Powell, 2013).

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5.2 Statistical Approach

To analyze differences in the mean consumption levels of 9 SSB subtypes, three way ANOVAS were performed on each beverage variable in SAS 9.2 (SAS Institute Inc.). Groups were compared on the basis of their age group, gender, and race/ethnicity categories. Adjustments to account for the possibility of false positives from multiple

comparisons were made using the Tukey-Kramer method, with a significance level at P<0.01.Results are presented in Figures 1 through 6.

5.3 Results

Intragroup comparisons based on age, gender, and race/ethnicity subgroups yielded surprisingly few differences between groups based on the large number of intragroup tests conducted. These significant differences are summarized in the table below, which also includes an aggregated category for calories from all SSBs and significant intragroup comparisons for combination beverage types. Four large themes emerge from this information and are identified below.

First, as has been observed in the literature at large, Black individuals are consuming significantly more calories from fruit drinks than many of their peers in age-matched and gender-matched groups. Female black toddlers get significantly more calories than white toddlers. Black young children get significantly more calories from fruit drinks than Mexican American children of the same age. Adolescent and young adult black males and females also get more calories from fruit drinks than their Other Hispanic / Other Race counterparts. Specific attention may be paid especially to young adult and adult black females who consume more calories from SSBs overall than the Other Hispanic / Other Race category for young adults and both Whites and the Other Hispanic / Other Race category for adults. While these intragroup comparisons should be interpreted with caution, the public health community would do well to be aware of these

general subpopulation trends to focus specific awareness or education campaigns for those populations who are getting excessive calories from certain beverage types in particular. The fruit drink beverage type, which contains beverages such as Sunny Delight, Fruit Nectars, Capri Sun is particularly insidious because packaging and marketing can lead consumers to believe that the beverages are good for them despite the high amounts of added sugars frequently contained in these beverages. More research is needed to understand specifically why the black community consumes more of these types of beverages and what might contribute to reductions in their intake.

Second, and most surprisingly, Table 23 is notable for what it does *not* contain. There were no significant differences in intragroup consumption in 7 of the 9 main SSB beverage types: Coffee Drinks, Energy Drinks, Sweetened Tea, Flavored Milk, Low Fat Flavored Milk, Sweetened Non-Dairy Beverages, and Flavored Water. This is useful information because we can see that drinks that have typically been associated with higher-income consumers such as Sweetened Non-Dairy Beverages (e.g. soy and almond milk), Coffee Beverages (e.g. Frappuccinos, and Café Mochas), and Flavored Water (e.g. Vitamin Water), do not necessarily discriminate on the basis of an age-gender-race/ethnicity groupings. Again, this observation should be taken with caution, as more advanced statistical techniques would be necessary to control for all other relevant factors.

Third, Figures 1 through 6 collectively provide valuable information about the role of several SSB subtypes that had not previously been considered. As has been noted, SSB consumption has largely focused around the role of Soda, Fruit Drinks, and

Energy/Sports Drinks. Although some attention has been paid to Sweetened Tea Beverages, much less has been paid to several other marginal categories – Flavored Milk, Low Fat Flavored Milk, Coffee Beverage, Sweetened Non-Dairy Beverages and Flavored Water. One of the more unique contributions of this analysis has been to shed light on the caloric role played by flavored milks, which include ready-to-drink Nesquik beverages, milk shakes, and strawberry milks. Together, regular and low fat flavored milks account for more calories than soda among children 2 to 5 and 6 to 11 for all race/ethnicity groups. Flavored milks also account for more calories than fruit drinks for children between 2 and 11 for all race/ethnicity groups except blacks. Flavored milks account for more calories than Energy Drinks and Sweetened Tea among all subgroups of individuals ages 12 to 19. They also account for more calories than Energy Drinks among all subgroups age 60 and older and for all female race/ethnic subgroups ages 20 to 59. Therefore, on the basis of calorie intake alone, flavored milks may legitimately be considered among the "usual suspects" that typically have only included Sodas, Fruit Drinks, and Energy Drinks.

Finally, in comparison with the "usual suspects", the role of Sweetened Non Dairy Beverages, Coffee Beverages, and Flavored Water in these NHANES study period overall has been marginal. However, given the explosive growth in the markets for Non-Dairy Beverages in the U.S., where — according to market research firm Euromonitor — sales increased ninefold from 2009 to 2015 (Whipp & Daneshkhu, 2016), further studies would do well to continue to monitor this as a separate SSB subcategory. As with Sweetened Non-Dairy Beverages, consumption of specialty coffee beverages such as

Cold Brews, Iced Coffees, and espresso-based beverages has increased significantly in recent years (Ward, 2017). Given the observed increase in consumption of energy-stimulating drinks in recent years (Kit et al., 2013), it would not be surprising to see larger caloric contributions from Coffee Beverages in future years. One particular limitation of this analysis is the fact that it aggregates data from 4 NHANES cycles from 2007-2014. Analyses on later cycles in particular may identify both Non-Dairy Beverages and Coffee Drinks as relatively larger contributors to overall caloric intake.

As is well known within the industry, innovation with new products and categories results in a relatively constant influx of novel beverage types (or similar products that are rebranded to appeal to new consumer segments). While the minor SSB subcategories included in this portion of the analysis have not had the assumed impact, the constant growth and change in the industry merits their inclusion in future research.

Table 23. Significant differences in Average per capita reported calories between age group-gender-race/ethnicity subgroups

Age Group	Gender	Race/Ethnicity Group 1 With Significantly Fewer Per Capita Calories	Race/Ethnicity Group 2 With Significantly More Per Capita Calories	Beverage Type	Group 1 Per Capita Calories	Group 2 Per Capita Calories
2 to 5	Female	Other Hispanic / Other Race	Mexican American	Soda	10.51	23.62
2 to 5	Female	White	Black	FruitDrink	24.21	57.47
6 to 11	Female	Mexican American	Black	FruitDrink	44.80	57.47
6 to 11	Female	White	Black	FruitDrink	24.21	57.47
6 to 11	Male	Mexican American	Black	FruitDrink	45.83	82.28
12 to 19	Female	Other Hispanic / Other Race	Black	FruitDrink	49.47	74.70
12 to 19	Male	Other Hispanic / Other Race	White	SSBs	195.38	276.93
12 to 19	Male	Other Hispanic / Other Race	White	Soda	94.81	148.09
12 to 19	Male	Other Hispanic / Other Race	Black	FruitDrink	43.80	81.05
20 to 39	Female	Other Hispanic / Other Race	Black	SSBs	124.81	198.35
20 to 39	Female	Other Hispanic / Other Race	Black	Soda	51.93	71.00
20 to 39	Female	Other Hispanic / Other Race	Black	FruitDrink	28.54	68.44
20 to 39	Female	White	Mexican American	FruitDrink	29.99	32.51
20 to 39	Female	Black	White	CoffeeCombo	15.10	27.78
20 to 39	Male	Other Hispanic / Other Race	Mexican American	SSBs	192.35	266.18
20 to 39	Male	Other Hispanic / Other Race	Mexican American	Soda	100.71	172.69
20 to 39	Male	Other Hispanic / Other Race	Black	FruitDrink	40.04	81.05
40 to 59	Female	Other Hispanic / Other Race	Black	SSBs	124.81	200.04
40 to 59	Female	White	Black	SSBs	150.64	200.04
40 to 59	Female	Other Hispanic / Other Race	Black	Soda	65.81	109.08
40 to 59	Female	Other Hispanic / Other Race	Mexican American	Soda	65.81	91.33
40 to 59	Female	White	Other Hispanic / Other Race	MilkCombo	1.53	11.48
40 to 59	Female	Black	Other Hispanic / Other Race	MilkCombo	3.00	11.48
40 to 59	Male	White	Black	FruitDrink	24.22	80.56
>=60	Female	White	Black	Soda	52.22	71.98
>=60	Female	White	Black	FruitDrink	16.04	48.96
>=60	Male	Other Hispanic / Other Race	Black	SSBs	69.52	189.14
>=60	Male	White	Black	SSBs	158.31	189.14
>=60	Male	Other Hispanic / Other Race	Black	Soda	33.38	95.19

Note. Data bars are scaled from 0 to the maximum number in the 'per capita calories' columns.

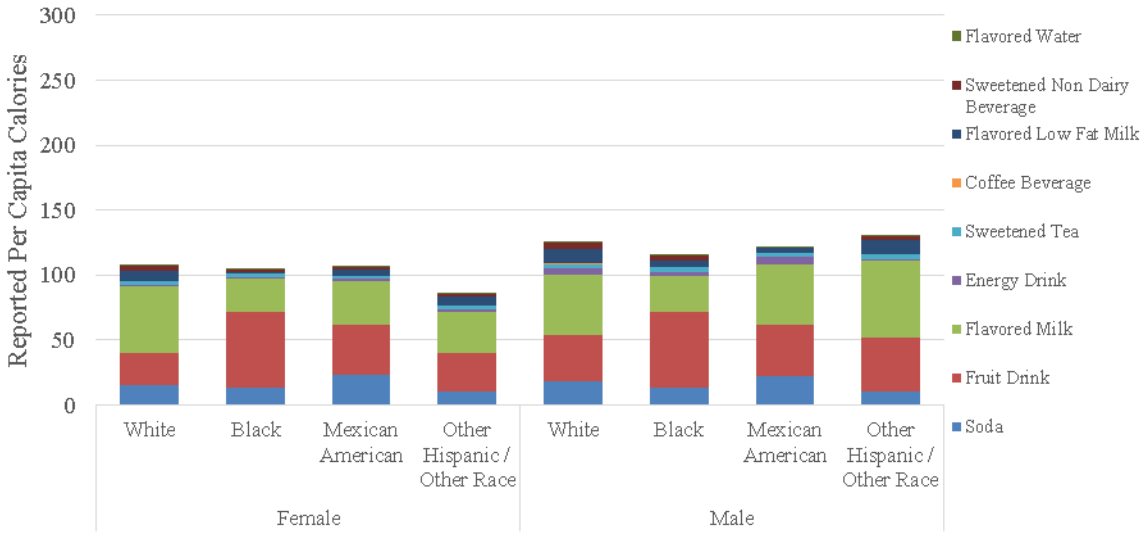


Figure 1. Average per capita daily reported total calories from 9 SSB subtypes for individuals ages 2 to 5 by race category and gender

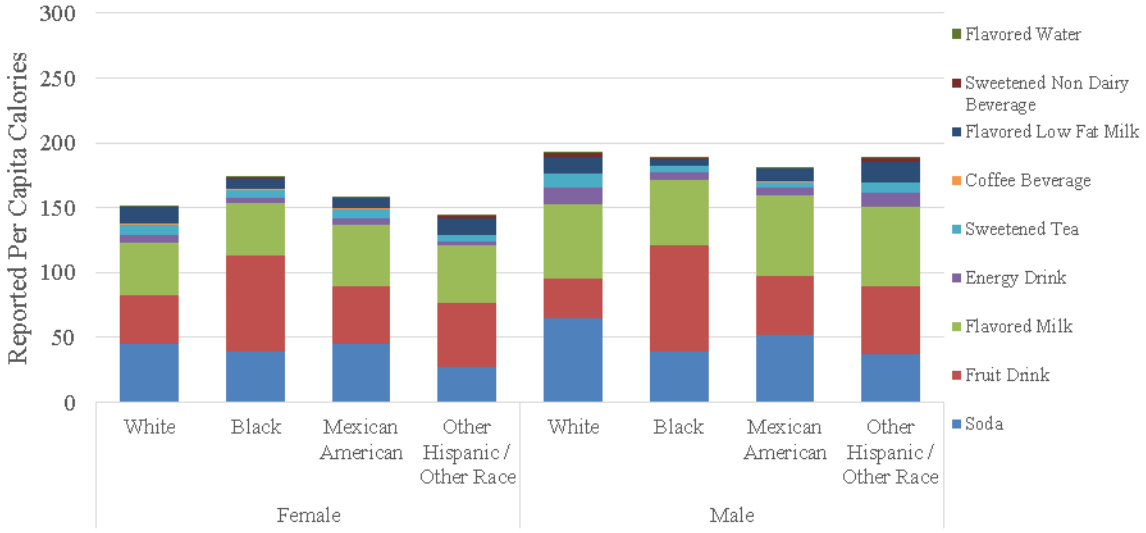


Figure 2. Average per capita daily reported total calories from 9 SSB subtypes for individuals ages 6 to 11 by race category and gender

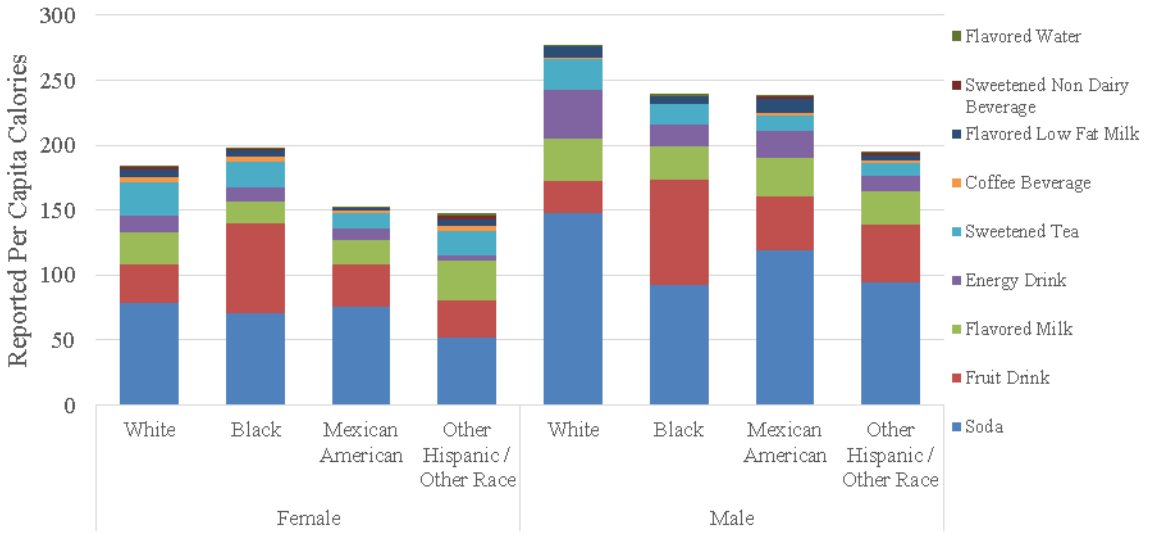


Figure 3. Average per capita daily reported total calories from 9 SSB subtypes for individuals ages 12 to 19 by race category and gender

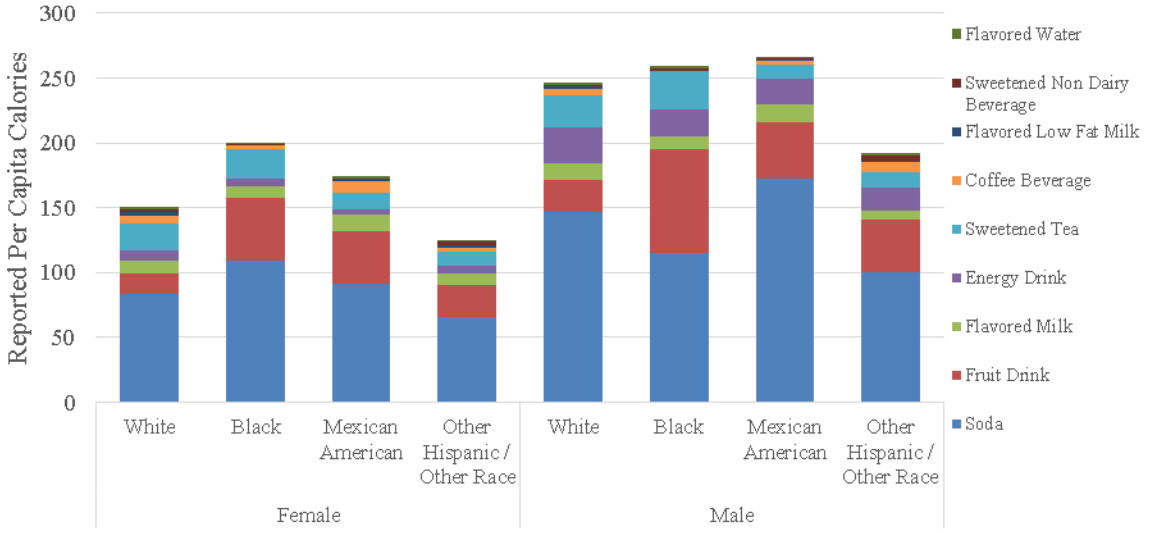


Figure 4. Average per capita daily reported total calories from 9 SSB subtypes for individuals ages 20 to 39 by race category and gender

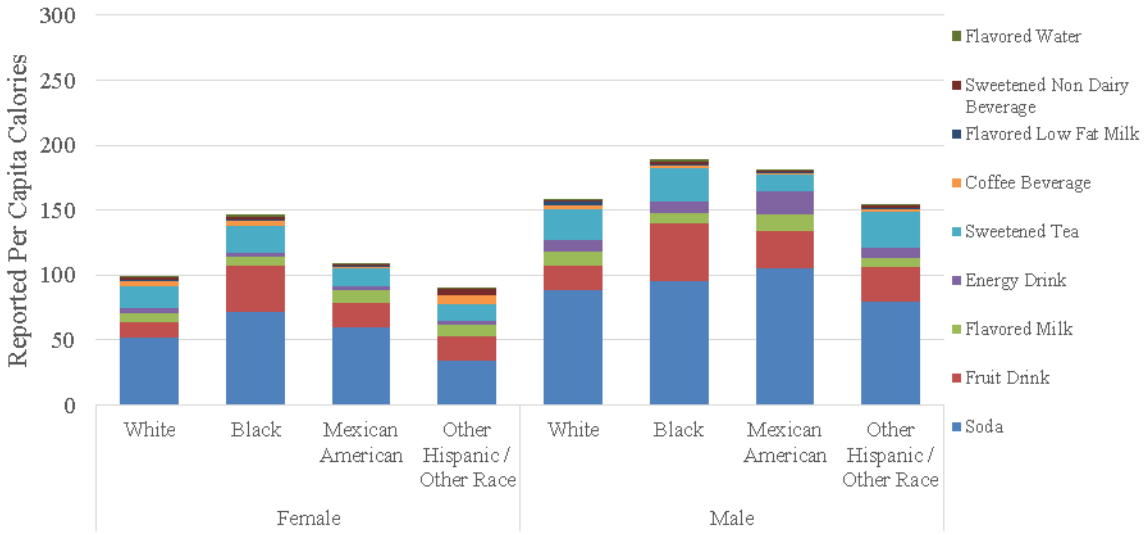


Figure 5. Average per capita daily reported total calories from 9 SSB subtypes for individuals ages 40 to 59 by race category and gender

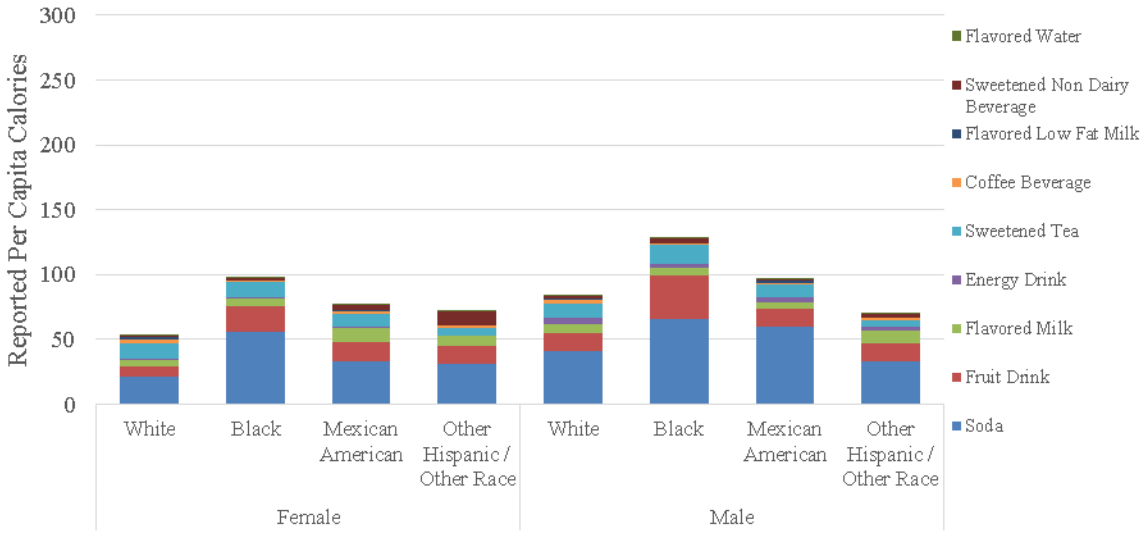


Figure 6. Average per capita daily reported total calories from 9 SSB subtypes for individuals age 60+ by race category and gender

CHAPTER 6: CONSUMPTION OVER TIME OF MAJOR SSB SUBTYPES AND COMBINATION BEVERAGES

As noted in the previous section, several recent studies have found that total SSB consumption has been in relative decline (Bleich et al., 2018; Han & Powell, 2013; Kit et al., 2013; Piernas et al., 2013). In the most recently available analysis, Bleich and colleagues found that caloric consumption of all SSBs decreased significantly between 2003 and 2014 for all age groups except those aged 60 and older. Calories from soda and fruit drinks, the two top caloric contributors, decreased for all children over the period. Calories from fruit drinks declined for all adults while calories from soda declined only for those adults aged 20 to 39 year olds and 40 to 59 years. Bleich and colleagues found no significant changes in caloric consumption were found in sports and energy drinks over the period for either adults or children.

6.1 Statistical Approach

To examine yearly consumption trends, one way ANOVAS were performed on each SSB category and several other sugary beverages or beverage combinations in SAS 9.2 (SAS Institute Inc.). Separate analyses were conducted for children (age 2 to 19) and adults (age 20+). Groups were compared on the basis of their NHANES Collection cycle. Adjustments to account for the possibility of false positives from multiple comparisons were made using the Tukey-Kramer method, with a significance level at $P<0.01$.

6.2 Results

Results for overall calories are presented in Tables 22 and 23 and graphically in Figures 7 and 8. Results for calories from added sugars only are presented in tables 24 and 25 and Figures 9 and 10.

Table 24. Average reported calorie intake for sugary beverage subcategories for children by NHANES survey cycle

Survey Year Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
2007-2008	189.0095^{A} (6.0928)	1.0082^{A} (0.447)	9.7307^{A} (1.3941)	0.6613^{A} (0.2385)	44.4027^{A} (1.8815)	35.414^{A} (2.4693)	7.519^{A} (2.399)	1.1727^{A} (0.3451)	79.7392^{A} (6.847)	9.3617^{A} (1.5654)	3.3995^{A} (0.9679)	1.938^{A} (0.6123)	9.1461^{A} (1.3448)	3.0792^{A} (0.639)	44.2888^{A} (2.9145)
2009-2010	190.5809^{A} (5.7404)	0.4^{A} (0.3266)	10.0021^{A} (1.8834)	1.3018^{A} (0.4075)	44.0371^{A} (3.2709)	45.2123^{A} (4.0476)	11.1808^{A} (1.4131)	0.9773^{A} (0.3185)	67.6054^{AB} (4.7891)	9.8641^{A} (1.7312)	1.5775^{A} (0.2353)	1.3032^{A} (0.3494)	6.3398^{A} (0.8606)	3.4369^{A} (0.4903)	44.7592^{A} (2.7904)
2011-2012	177.463^{AB} (7.5602)	2.0146^{A} (0.5532)	12.4658^{A} (1.9419)	0.4285^{A} (0.1202)	39.9877^{A} (2.5828)	37.1185^{A} (5.1012)	8.7178^{A} (1.3819)	3.209^{A} (1.0633)	57.9478^{B} (3.5599)	15.5733^{A} (1.9362)	2.505^{A} (0.4747)	0.834^{A} (0.225)	6.6718^{A} (0.9657)	3.1878^{A} (0.5513)	42.7324^{A} (1.93)
2013-2014	160.8337^{B} (8.1598)	1.5105^{A} (0.4002)	17.1288^{A} (5.1659)	0.4441^{A} (0.1592)	27.9082^{B} (2.0128)	34.7463^{A} (3.3742)	7.0078^{A} (1.3868)	1.318^{A} (0.2114)	56.0975^{B} (3.3322)	14.6726^{A} (2.5975)	2.2004^{A} (0.4338)	0.7774^{A} (0.1561)	5.4851^{A} (1.1852)	4.1542^{A} (1.0914)	41.521^{A} (2.8022)
Pct of total intra-group comparisons significant	33.3%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

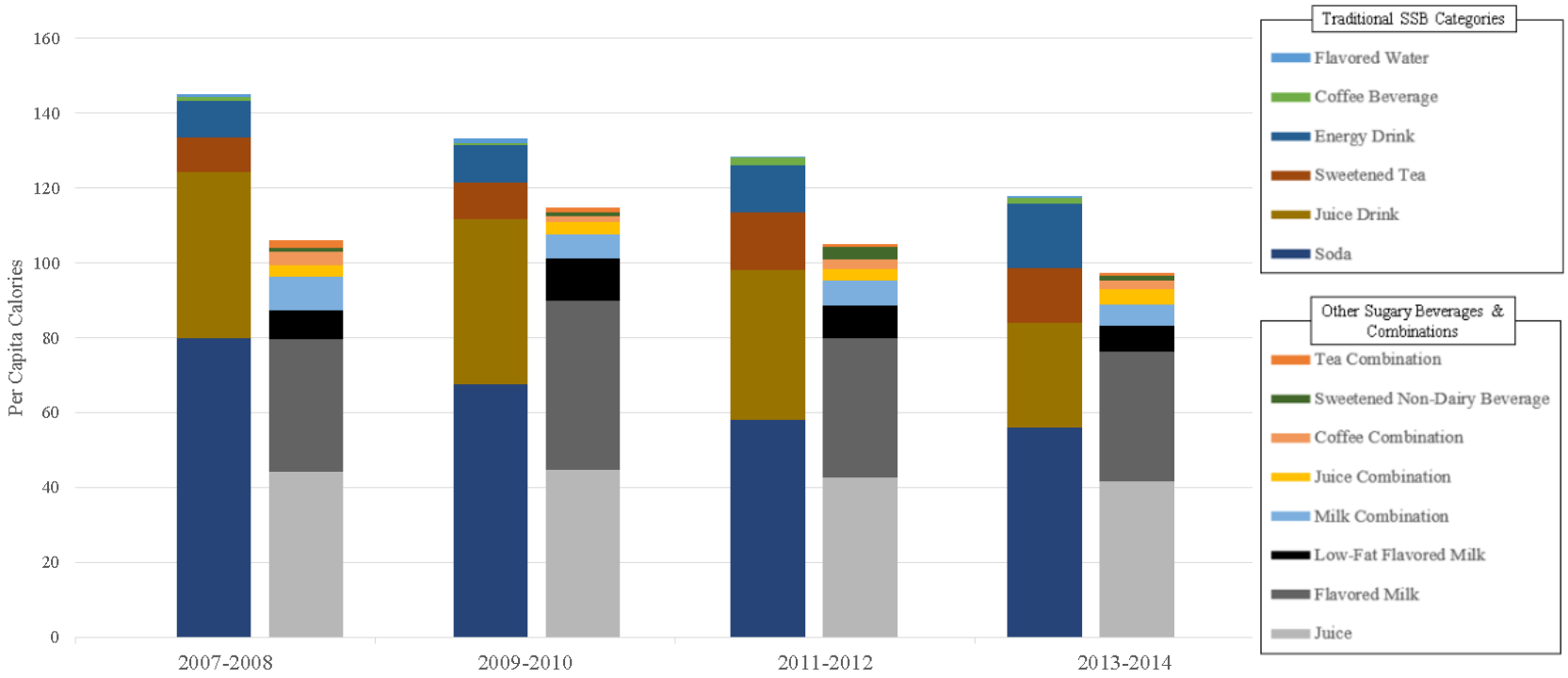
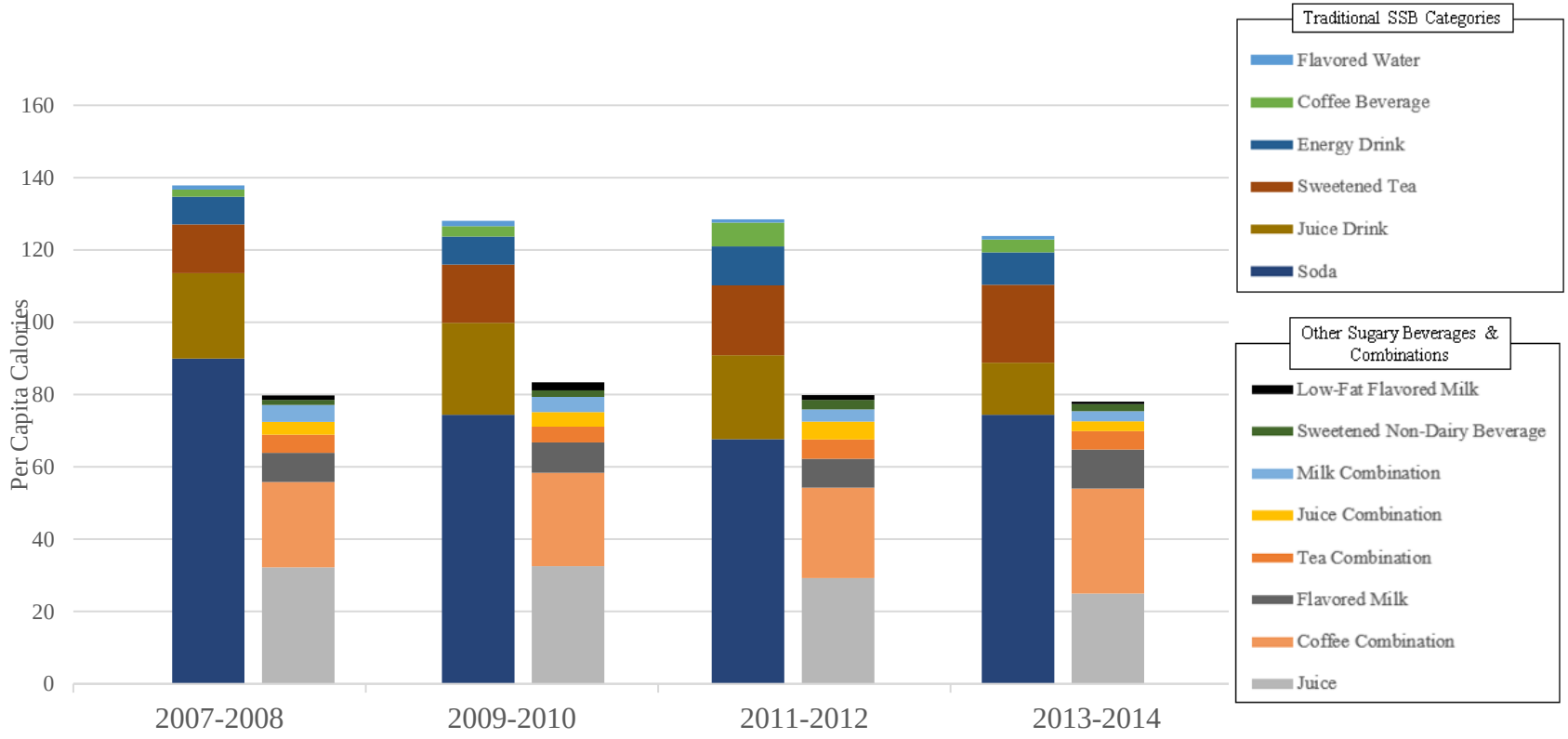


Figure 7. Per capita calories from sugary beverages and combinations by NHANES collection cycle for children

Table 25. Average reported calorie intake for sugary beverage subcategories for adults by NHANES survey cycle

Survey Year Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination	Juice
2007-2008	148.576^{A} (8.244)	1.9901^{B} (0.3693)	7.5894^{A} (1.1004)	1.1848^{A} (0.2314)	23.6253^{A} (2.0346)	8.0612^{A} (0.8821)	1.2196^{AB} (0.2509)	1.4436^{B} (0.2542)	89.9201^{A} (7.9848)	13.542^{A} (1.3474)	23.6136^{A} (1.3402)	5.0052^{A} (0.4956)	4.7198^{A} (0.7109)	3.4905^{AB} (0.3485)	32.2278^{A} (1.5284)
2009-2010	140.3929^{A} (3.6906)	2.8593^{AB} (0.4502)	7.7785^{A} (0.5513)	1.4919^{A} (0.2499)	25.3734^{A} (1.6886)	8.3519^{A} (0.7914)	2.2249^{A} (0.4777)	1.7651^{AB} (0.2621)	74.4272^{A} (3.6912)	16.1207^{A} (2.3954)	25.8373^{A} (1.7772)	4.3318^{A} (0.5467)	4.1811^{A} (0.4334)	4.0929^{AB} (0.2752)	32.5685^{A} (1.1673)
2011-2012	140.4216^{A} (5.1885)	6.6142^{A} (1.4428)	10.7816^{A} (1.6051)	0.8773^{A} (0.1486)	23.156^{A} (2.6919)	8.0127^{A} (1.3177)	1.2794^{AB} (0.3049)	2.6843^{A} (0.3201)	67.693^{A} (4.4317)	19.3231^{A} (2.6107)	25.012^{A} (1.4279)	5.311^{A} (0.6795)	3.3218^{A} (0.5341)	4.9694^{A} (0.6866)	29.2398^{AB} (1.9045)
2013-2014	137.3091^{A} (8.6555)	3.5867^{AB} (0.7288)	8.8973^{A} (0.9788)	1.015^{A} (0.2096)	14.4136^{B} (1.0211)	10.7724^{A} (0.9989)	0.6615^{B} (0.1805)	1.9779^{AB} (0.3674)	74.3878^{A} (5.6097)	21.597^{A} (3.105)	29.0892^{A} (2.0389)	5.1039^{A} (0.7741)	2.7829^{A} (0.3992)	2.7258^{B} (0.4632)	24.9413^{B} (1.4975)
Pct of total intra-group comparisons significant	0.0%	16.7%	0.0%	0.0%	50.0%	0.0%	16.7%	16.7%	0.0%	0.0%	0.0%	0.0%	0.0%	16.7%	33.3%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.



S **Figure 8. Per capita calories from sugary beverages and combinations by NHANES collection cycle for adults**

Table 26. Average reported calorie intake from added sugars for sugary beverage subcategories for children by NHANES survey cycle

Survey Year Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination
2007-2008	141.1547^{A} (5.1111)	0.0256^{A} (0.0112)	7.8183^{A} (1.1412)	0.5487^{A} (0.2107)	36.8689^{A} (1.5305)	9.192^{A} (0.6443)	2.2354^{A} (0.7538)	0.3447^{A} (0.0996)	73.2373^{A} (6.4226)	8.6581^{A} (1.4532)	1.5004^{A} (0.4107)	1.6789^{A} (0.5411)	2.1337^{A} (0.4019)	0.8707^{A} (0.1307)
2009-2010	134.7964^{AB} (4.842)	0.0152^{A} (0.0132)	7.7691^{A} (1.5207)	1.2268^{A} (0.3912)	36.1961^{A} (2.7902)	11.9034^{A} (1.1289)	3.4139^{A} (0.5014)	0.3068^{A} (0.1031)	61.7263^{AB} (4.4163)	9.2138^{A} (1.6249)	0.8579^{A} (0.1819)	1.124^{A} (0.3037)	1.4544^{A} (0.1862)	1.0061^{A} (0.1498)
2011-2012	126.8887^{AB} (3.8584)	0.0476^{A} (0.0141)	9.9263^{A} (1.6111)	0.3732^{A} (0.1142)	31.3318^{A} (1.8756)	9.3876^{A} (1.2984)	2.3993^{A} (0.3942)	1.149^{A} (0.3784)	52.9088^{B} (3.2817)	14.6679^{A} (1.8431)	1.0698^{A} (0.2023)	0.7204^{A} (0.2001)	1.5314^{A} (0.2954)	1.0364^{A} (0.2858)
2013-2014	114.6323^{B} (6.8628)	0.0429^{A} (0.011)	13.0417^{A} (3.782)	0.3722^{A} (0.1439)	23.2572^{B} (1.6533)	8.2769^{A} (0.8432)	2.0774^{A} (0.4182)	0.5515^{A} (0.0811)	51.6543^{B} (3.2428)	12.6483^{A} (2.2917)	0.9473^{A} (0.2349)	0.6527^{A} (0.1401)	0.957^{A} (0.2114)	1.1321^{A} (0.365)
Pct of total intra-group comparisons significant	16.7%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

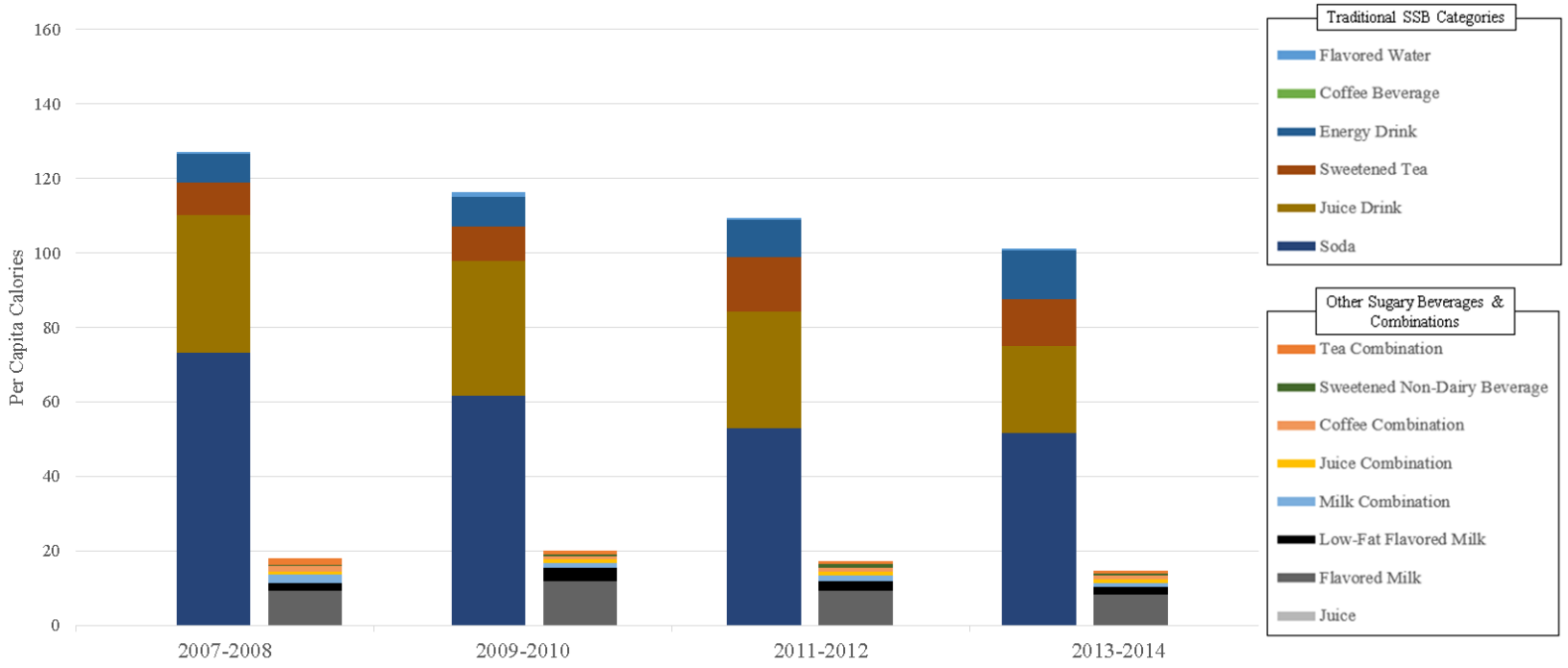


Figure 9. Per capita calories from added sugars of sugary beverages and combinations by NHANES collection cycle for children

Table 27. Average reported calorie intake from added sugars for sugary beverage subcategories for adults by NHANES survey cycle

Survey Year Category	All SSBs	Coffee Beverage	Energy Drink	Flavored Water	Fruit Drink	Flavored Milk	Flavored Low Fat Milk	Sweetened Non-Dairy Beverage	Soda	Sweetened Tea	Coffee Combination	Tea Combination	Milk Combination	Juice Combination
2007-2008	129.5769^{A} (7.5614)	0.0557^{B} (0.0099)	6.1278^{A} (0.8511)	1.0933^{A} (0.2189)	19.2399^{A} (1.705)	2.4221^{A} (0.2408)	0.3644^{AB} (0.077)	0.4416^{B} (0.0848)	83.0946^{A} (7.4606)	12.2959^{A} (1.2284)	12.1156^{A} (0.7457)	3.8786^{A} (0.4229)	0.965^{A} (0.2125)	1.4703^{A} (0.2053)
2009-2010	121.67^{A} (3.5226)	0.0765^{AB} (0.0115)	6.1749^{A} (0.4603)	1.3983^{A} (0.2358)	20.7063^{A} (1.4329)	2.623^{A} (0.2066)	0.7228^{A} (0.166)	0.5452^{B} (0.0908)	68.6229^{A} (3.452)	14.9024^{A} (2.2692)	12.8452^{A} (1.0634)	3.2421^{A} (0.4927)	0.7311^{A} (0.0795)	1.8376^{A} (0.1728)
2011-2012	118.3346^{A} (4.95)	0.1486^{A} (0.0315)	8.595^{A} (1.2103)	0.8044^{A} (0.1421)	18.1732^{A} (2.1671)	2.3719^{A} (0.4343)	0.3389^{AB} (0.0862)	0.9905^{A} (0.1357)	62.1863^{A} (4.0915)	18.0941^{A} (2.4768)	11.5537^{A} (0.7228)	4.1511^{A} (0.5887)	0.7655^{A} (0.151)	1.9402^{A} (0.3049)
2013-2014	119.9924^{A} (7.836)	0.0949^{AB} (0.0192)	7.1477^{A} (0.8236)	0.9141^{A} (0.2071)	12.0069^{B} (0.8531)	2.8421^{A} (0.2659)	0.1812^{B} (0.0445)	0.8374^{AB} (0.1574)	68.4744^{A} (5.2209)	18.8381^{A} (2.7728)	12.9033^{A} (0.8832)	4.0787^{A} (0.6624)	0.6003^{A} (0.0946)	1.0717^{A} (0.2909)
Pct of total intra-group comparisons significant	0.0%	16.7%	0.0%	0.0%	50.0%	0.0%	16.7%	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Note. Standard errors are included in parentheses. Variable levels sharing a common superscript are not statistically different from one another. Data bars are scaled from 0 to the maximum amount in the 'All SSBs' category to aid interpretation.

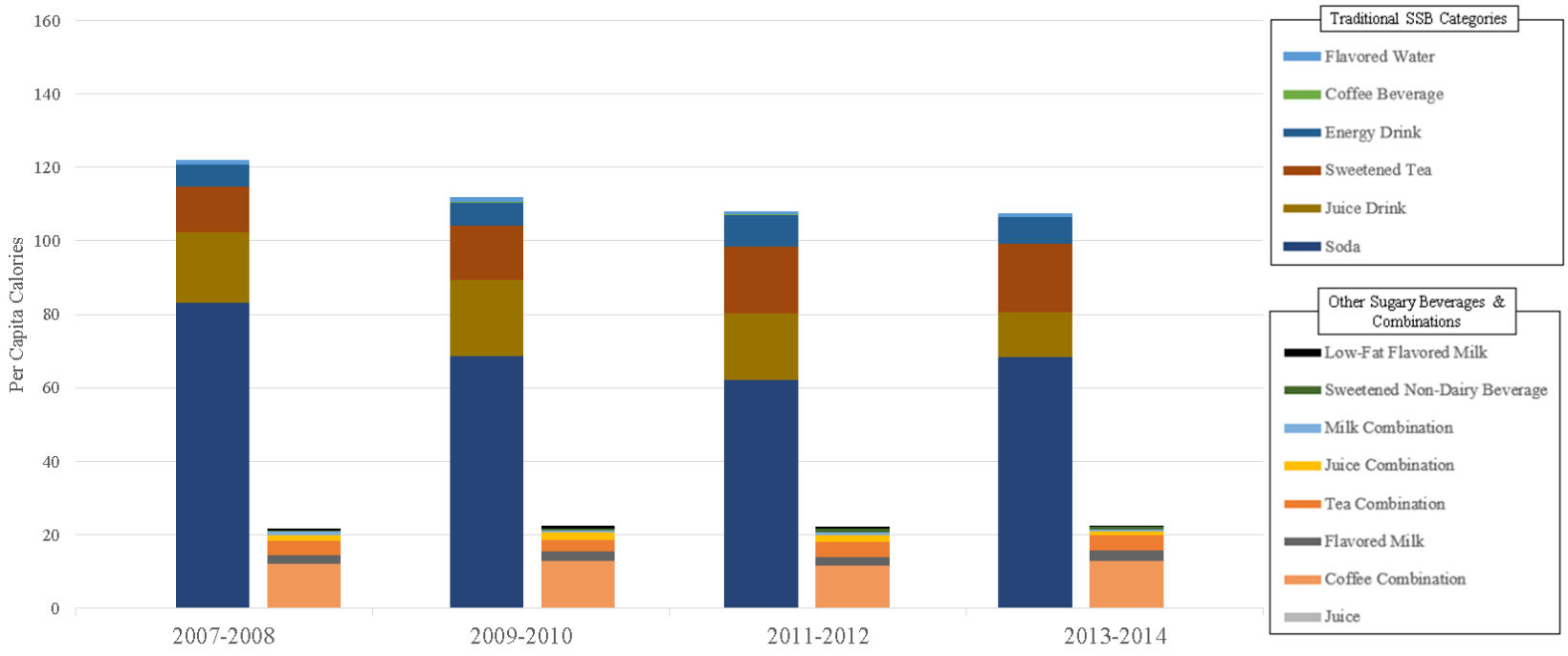


Figure 10. Per capita calories from added sugars of sugary beverages and combinations by NHANES collection cycle for adults

From the 4 NHANES cycles from 2007 to 2014, children's reported caloric consumption did not change significantly for 12 of the 14 sugary beverage subcategories analyzed. Reported consumption of SSB calories overall was significantly less in 2013-14 in comparison to consumption in either 2007-08 or 2009-10. Consumption of Fruit drinks and Sodas exhibited a similar pattern: Reported consumption in 2013-14 of Fruit Drinks was significantly smaller than any other NHANES cycle, and reported consumption of calories from Soda in both 2011-12 and 2013-14 was significantly smaller than reported consumption in 2007-2008.

Reported calories coming specifically from added sugars decreased for children over the 4-cycle period, but the caloric consumption is 2013-14 is only statistically different from the 2007-2008 period. Calories from added sugars from Fruit Drinks and Sodas have also decreased in recent years for children: consumption from Fruit Drinks was lower in 2013-14 than any other NHANES cycle and consumption of Soda was lower in 2011-12 and 2013-14 than in 2007-2008. No other significant decreases were observed in 11 of the 13 sugary beverage subcategories analyzed (juice was not included because juice did not have added sugars).

Among adults, no significant differences were observed in reported caloric consumption for 8 of the 14 sugary beverage subcategories analyzed. Most notably, all SSBs did not exhibit significant differences in mean reported consumption between any given pairwise comparison. Reported consumption of Fruit Drinks was significantly less in 2013-14 in comparison to any other cycle. Consumption of Flavored Low-Fat Milk was less in 2013-14 in comparison to 2009-10 only and consumption of Juice was

significantly less in 2013-14 only in comparison to 2007-08 and 2009-10. Consumption of added sugars from Sweetened Non-Dairy Beverages was less in 2011-2012 in comparison to 2007-2008 only.

In terms of the reported calories coming from added sugars for adults, no significant decreases were observed for total calories from added sugars from all SSBs or from Soda. Consumption of Fruit Drinks was significantly lower in 2013-14 in comparison with every other NHANES collection cycle. Reported calories from added sugars was also lower for Flavored Low-Fat Milk in 2013-14, but only in comparison to the 2009-10 collection cycle. Although the magnitude of the increase is low, reported consumption of calories from added sugars of Coffee Drinks increased slightly over the period – with the level in 2011-12 significantly more than the level in 2007-2008.

It should be noted explicitly that while these findings are not entirely consistent with the most recently available published analysis of beverage consumption in the NHANES by Bleich and colleagues (2018). The findings in this study showed consistently higher reported caloric consumption levels for Soda for every age level, but slightly more comparable findings for energy and fruit drinks. There are three major reasons for this difference. First, while most other studies of SSB consumption – including that of Bleich et al. – do not include flavored milks, this study did include flavored milks as an SSB category for the simple reason that flavored milks often contain added sugars. This accounts for the higher total calories from all SSBs found in this study. Second, this study was unique in studies of its kind because it included a second day of dietary data. NHANES analytic tutorials provided by the CDC note that a

sequencing effect may be in operation for dietary recall in that respondents may recall fewer items or calories on the first day than on the second day (CDC/National Center for Health Statistics, 2018). While collecting 2 days worth of data is not the common practice, this does increase the precision of estimates and is consistent with the recommendation to use as many 24h recalls as possible as advised by Black (2000a) and Hébert et al. (2014). The third reason for the difference in estimates is because of differences in coding schemes. The Synthesized Beverage Coding System is the most precise beverage coding system available because it cross-references its schema to the What We Eat In America food categories and the information about added sugar content available in the Food Patterns Equivalents Database. Failing to account for these other sources can lead to both false positives (such as categorizing seltzers with no added sugars as SSBs) and false negatives (categorizing Fruit Drink beverages as Juices even though they contain large amounts of added sugars). In addition, it is very important to cross check beverage coding schemes from year to year as FNDDS food codes and their added sugar content may change over time.

The finding that total SSB consumption and total Soda consumption has not decreased over time for adults speaks to the importance of coding beverages with a consistent and thorough schema to accurately describe public consumption trends in this politically important topic.

CHAPTER 7: CONCLUSION

Although descriptive in nature, this work's major contribution has been in laying the groundwork for future beverage dietary studies. The first way in which this was accomplished was by documenting the major systems that have been used to categorize different types of SSBs and proposing the Synthesized Beverage Categorization System – the most precise SSB typology available today. Second, this work provided a large number of basic analyses of mean reported group consumption by calorie. While this study remained consistent with others of its kind in including all valid NHANES respondents, this study was novel in its inclusion of both days of dietary data, which improved the precision of the estimates. By providing the first estimates of several important combination variables, this work also expanded the list of the "usual suspects" that are typically considered in nutritional epidemiological studies of beverage consumption. Most notably, this analysis sheds light on the large caloric role that can be played by Flavored Milks for both adults and children, Milk Combinations for children, and Coffee Combinations for adults. This work also echoed the conclusion found in recent analyses about consumption of Fruit Drinks in the African-American community.

This study has several limitations. As discussed, because of the limitations with self-report data, these findings should not be interpreted as usual intakes (Hébert et al., 2014). At best, this should serve as a starting point for future research on habitual beverage intake. Secondly, these analyses produce only group means that should be interpreted with caution. More advanced statistical techniques would be necessary to

control for more variables to do anything more than preliminarily suggest that these represent true group patterns.

This work also suggests a number of directions for future research. First, results from Chapter 4 suggested that more research could shed light on the ways in which children's beverage consumption patterns outside of the home differs from their parents and how these are mediated by other factors such as beverages available in a school environment. The findings from Chapter 5 indicate that while the role of most combination beverages has been marginal in terms of their overall contribution to reported caloric intake the role of other beverage types like Flavored Milk and Coffee . The results from Chapter 6 indicate that while Sodas and Fruit Drinks are still the most significant contributors to caloric intake across the board, continued monitoring of intake from Flavored Milks and Coffee Combinations especially is merited in the future as beverage industry marketing campaigns seek to distance themselves away from Soda. Finally, Chapter 6 suggests that the U.S. is by no means "out of the woods" in terms of sugary drink consumption. Clearly, continued vigilance is necessary to reduce added sugar intake among American consumers, and this remains true for beverages.

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